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May 1993

JAPANESE AEROSPACE SCIENCE AND TECHNOLOGY 1992

A BIBLIOGRAPHY WITH INDEXES

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INFORMATION

NASA SP-7104

May 1993

JAPANESE AEROSPACE SCIENCE AND TECHNOLOGY 1992

A BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration
Scientific and Technical Information Program
Washington, DC

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INTRODUCTION

The purpose of this bibliography is to assist the NASA R&D effort by indicating some of Japan's more recent technological developments. The coverage is broad in scope. Items of Japanese origin or about Japanese developments were selected from the NASA Scientific and Technical Information Database, which emphasizes aerospace. The first bibliography in this series, *Japanese Science and Technology, 1983-1984* (NASA SP-7054), covered two years; since then they have been issued annually. This bibliography, the ninth in the series, includes all items accessioned in 1992 which are of Japanese intellectual origin or were indexed with the terms "Japan," "Japanese Space Program," or "Japanese Spacecraft."

Users unfamiliar with the Japanese language may find the following information useful.

Japanese names are normally written with the family name first, followed by the personal name; e.g., Tanaka (family name) Ryohei (personal name). However, some authors familiar with Western name order will write their names Personal Name Family Name; e.g., Ryohei Tanaka. A common convention to eliminate possible confusion is to write the surname in all capital letters; e.g., Ryohei TANAKA or TANAKA Ryohei. When an unfamiliar author cannot be found indexed under what is assumed to be the surname, consider also looking under what is assumed to be the personal name.

A variety of systems are used to represent the sounds of Japanese in the Latin alphabet, a process known as "romanization." The preferred romanization system for items in this bibliography is the Modified Hepburn System, the most widely used and straight-forward system. However, if an author provides another romanization of his or her name, that romanization is used. As a result, the same author may be cited in different sources in a variety of ways. For example, the surname "Sato" can also be romanized as "Satoh," "Satow," or "Sotou." The following information will help the user identify a desired author's name, in any of its possible forms.

This	may also be romanized as	in this situation.	Example
o	oh, ou, ow, oo, o ^h	when it is a long vowel.	Sato, Satoh, Satow, Satoo, Satou.
n	m	before b, m, or p.	shinbun, shimbun
n	n'	When "n" is a separate syllable.	kenichi, ken'ichi
shi	si	rarely.	shimbun, sinbun
tsu	tu	rarely.	tsunami, tunami
chi	ti	rarely.	ichi, iti

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TYPICAL REPORT CITATION AND ABSTRACT

ON MICROFICHE
↓

ACCESSION NUMBER	→ N92-10153#	Sandia National Labs., Albuquerque, NM.	← CORPORATE SOURCE
TITLE	→ SINTERED COMPACTS FOR HEAT SINKS AND PROCESS FOR FABRICATING SAME Patent Application		
AUTHORS	→ AKIO HARA, inventor (to Sumitomo) (Sumitomo Electric Industries Ltd., Itami (Japan).) and SHUJI YATSU, inventor (to Sumitomo) (Sumitomo Electric Industries Ltd., Itami, Japan) Nov. 1990		← PUBLICATION DATE
	8 p Transl. into ENGLISH of Japanese Patent Application No. 32,154, 1987		
CONTRACT NUMBER	→ (Contract DE-AC04-76DP-00789)		← AVAILABILITY SOURCE
REPORT NUMBERS	→ (DE91-018438; ALS/TR-90-021) Avail: CASI HC A02/MF A01		← PRICE CODE

The present invention relates to sintered compacts for heat sinks and to a process for their fabrication. Over the past few years, the semiconductor devices employed in high-field and high-current density applications have been adopted for practical use. Because power consumption density is especially high in the active regions of semiconductor lasers and IMPATT devices, modifications that prevent temperature rises in the devices are necessary. As a result, much attention has been devoted to materials which have a high thermal conductivity and are capable of serving as heat sinks. DOE

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

ACCESSION NUMBER	→ A92-24593		
TITLE	→ A TWO-DIMENSIONAL STRESS ANALYSIS OF BUTT ADHESIVE JOINTS FILLED WITH RIGID CIRCULAR FILLERS IN AN ADHESIVE SUBJECTED TO TENSILE LOADS		
AUTHORS	→ KATSUHIRO TEMMA (Kisarazu National College of Technology, Japan), TOSHIYUKI SAWA, and TETSU HIROSHIMA (Yamanashi University, Kofu, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, Jan. 1992, p. 30-37. refs Copyright		← AUTHORS' AFFILIATION
			← JOURNAL TITLE
			← PUBLICATION DATE

This paper deals with a two-dimensional stress analysis of a butt adhesive joint with rigid fillers in an adhesive subjected to a tensile load. Assuming that adherends are rigid and replacing an adhesive with a finite strip including rigid fillers, the analysis was done using the two-dimensional theory of elasticity in order to examine the joint strength. The effects of the location and size of rigid fillers on the stress distributions around the fillers and at the interfaces were shown by numerical calculations. For verification, photoelastic experiments were performed. The analytical result was in fairly good agreement with the experimental result. It was seen that based on the amount of shift of the location and the filler diameter, the joint strength was more improved than that of the joints without fillers. Author

JAPANESE AEROSPACE SCIENCE AND TECHNOLOGY

A Bibliography with Indexes

MAY 1993

01

AERONAUTICS (GENERAL)

A92-23060

SCIENTIFIC BALLOONING IN JAPAN

N. YAJIMA, H. HIROSAWA, and J. NISHIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan) (Thirty years of scientific ballooning in India; Symposium, Hyderabad, India, Oct. 22-24, 1990, Selected Papers. A92-23051 08-99) Indian Journal of Radio and Space Physics (ISSN 0367-8393), vol. 20, June-Aug. 1991, p. 206-208. refs

Copyright

A survey of the scientific ballooning activities in Japan is presented and the permanent balloon launching facility at Sanriku Balloon Center is described. Consideration is given to three specific scientific balloon projects: a long-duration flight using the boomerang balloon technique, a transoceanic flight over the East China Sea, and the 'polar patrol balloon' over Antarctica. R.E.P.

A92-35918

ENGINE MAINTENANCE TECHNOLOGY AND ITS DEVELOPMENT

SHIN KOGANE Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 224-228. In Japanese. refs

Monitoring technology for aircraft engines is presented. The aircraft integrated monitoring system (AIMS), the aircraft condition monitoring system (ACMS), the central maintenance computer system (CMCS), and the ARINC communication addressing and reporting system (ACARS) are discussed. Y.P.Q.

A92-38201

INTERNATIONAL AEROSPACE SYMPOSIUM 90, NAGOYA, JAPAN, NOV. 26, 27, 1990, PROCEEDINGS

Symposium sponsored by Chubu Aeronautics and Space Technology Development Association. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, 166 p. In Japanese and English. For individual items see A92-38202 to A92-38220.

The present conference discusses intelligent adaptive structures, space robots, design considerations of space structures, solar sail design, tilt-wing aircraft, the Asuka quiet STOL research aircraft, a prospective civil STOL transportation system, commuter helicopters, the scientific use of Space Station Freedom, materials science in space, and earth observations from space. Also discussed are the human exploration of Mars, advanced aerospace structures, materials and structures for ESA's Hermes manned vehicle, robotics applications in aerospace manufacturing, aircraft maintenance, novel processes in commercial aircraft design, and computer-integrated manufacturing. O.C.

A92-38217

AIRCRAFT MAINTENANCE SUPPORT SYSTEM

MASATO TSUKAMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: International Aerospace Symposium 90, Nagoya,

Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 131-138. In Japanese. refs

Advanced technologies are being applied to aircraft and ground support equipment for maintenance work. Voice synthesizers or voice recognizers are being developed and are being improved for practical use. Computer software for the aircraft maintenance support system is discussed. Y.P.Q.

A92-38220

PRODUCTION TECHNOLOGIES AND AIRCRAFT DESIGN

TSURUO TORIKAI (Japan Aircraft Development Corp., Tokyo) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 159-163. In Japanese.

The development of materials for Japanese military aircraft since World War II is reviewed. Integrating the manufacturing technology from the early phase of the aircraft design is described. Y.P.Q.

A92-41781

ENGINEERING AND TECHNOLOGY JAPANESE AIRCRAFT/SPACECRAFT

TADAYUKI TANIOKA (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 17-22. In Japanese.

Comparisons of aeronautical and astronautical industrial scales and performance among the industrial countries are presented. Composite materials for aircraft fuselage skin and rocket tank wall are discussed. Y.P.Q.

A92-43095

AIRCRAFT SYMPOSIUM, 28TH, TOKYO, JAPAN, NOV. 7-9, 1990, PROCEEDINGS

Symposium sponsored by Japan Society for Aeronautical and Space Sciences and Japan Aeronautical Engineers' Association. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, 681 p. In Japanese and English. For individual items see A92-43096 to A92-43248.

Papers are presented on such topics as hypersonic test facilities, helicopter rotor aeroelastic stability and response, the evaluation of the structural integrity of aging aircraft, the effect of temperature on composite panel flutter, and the dynamic response and aeroelastic analysis of a propeller blade. Consideration is also given to the optimization of blade structure to reduce rotor vibration, a method for the evaluation of runway roughness, the inspection of composite materials with an advanced ultrasonic flaw detector, the characteristics of a liquid crystal flat panel display, cockpit display trends, and the aerodynamic design of a nonplanar airfoil using the inverse method with Navier-Stokes equations. B.J.

A92-43137

THE PROGRESS OF A STOL PROJECT

MIKIHICO MORI, YOSHIO HAYASHI (National Aerospace Laboratory, Chofu, Japan), ISAO KAGEYAMA, and NOBUYUKI TAKASAKI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 196-199. In Japanese.

ABSTRACTS

01 AERONAUTICS (GENERAL)

The development of the STOL research aircraft Asuka is presented. The system functions, aerodynamic characteristics, and flight performance have been tested. The preparation of the data base system for STOL has been completed. The system includes design, wind tunnel test, and flight test data. Y.P.Q.

A92-43141

AIRCRAFT RELIABILITY AND MAINTAINABILITY

Y. KAWASHIMA (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 212-219. In Japanese.

An aircraft reliability management system and safety design standard are discussed. The inspection of structural fatigue damage and fault monitoring and maintenance of aircraft engines are described and an aircraft condition monitoring system is outlined. Y.P.Q.

A92-43147

A STUDY OF AIRCRAFT SURFACE COATING TECHNOLOGY

TAKIHIKO SORAKU (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 248-251. In Japanese.

A surface coating technology especially suitable for helicopter surfaces is described. The operational conditions are given, such as room temperature and ventilation. The steps of the coating technology are described and illustrated. Y.P.Q.

A92-43148

STUDY ON THE MAINTAINABILITY AND INSPECTION OF THE STOL RESEARCH AIRCRAFT ASUKA

MASATAKA HAKUI (National Aerospace Laboratory, Chofu, Japan) et al. IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 252-255. In Japanese.

Ground and flight tests of the STOL research aircraft Asuka are discussed. The phased flight tests are emphasized, and the application of the stability and control augmentation system (SCAS) for the tests is discussed. Y.P.Q.

A92-43153

REPAIR OPERATION ON A COMPOSITE MATERIAL STRUCTURE

AKIO SATO (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 272-275. In Japanese.

The structure of the damaged section of composite materials is examined. The repair operation for a carbon fiber reinforced plastic plate is described. Y.P.Q.

A92-43157

UTILIZING THE FAULT MONITORING SYSTEM FOR THE A320 AIRCRAFT

K. TANIKAWA and ICHIRO BABA (All Japan Air Transportation, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 288-291. In Japanese.

The structure and functions of the centralized fault display system (CFDS) are presented. The airborne integrated data system (AIDS) and the aircraft communications addressing and reporting system (ACARS) are discussed. The electronic centralized aircraft monitor system is also outlined. Y.P.Q.

A92-43246

STRINGER SUBSYSTEM AUTOMATION

KIYATAKA ABE and W. TANABE (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 648-651. In Japanese.

A test facility for stringer subsystem automation is described. Test results are analyzed, including positioning accuracy and processing quality. Y.P.Q.

A92-43247

DEVELOPMENT OF AN AUTOMATIC METAL SHEET WORKING MACHINE FOR INTERIOR STRUCTURE

M. WATANABE (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 656-659. In Japanese.

The characteristics of an automatic sheet metal working machine are described. Application to the 767 airframe panel structure is discussed. Y.P.Q.

A92-43248

AUTOMATION OF COMPOSITE MATERIAL STRUCTURE INSTALLATION

H. SANO (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 660-663. In Japanese.

The carbon fiber reinforced plastics for YXX horizontal tail wing structures are presented. The design technology for automatic operation is discussed. The safety requirement for automatic operation is reviewed. Y.P.Q.

A92-46448

SUNRISE AEROSPACE

KEVIN O'TOOLE Flight International (ISSN 0015-3710), vol. 141, no. 4321, June 3, 1992, p. 23-25.

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An overview is presented that examines the growth and dominance in productivity that Japan has achieved in the automotive, computer and consumer electronics fields. The potential and future role of the aerospace industry in the major countries of the Pacific Rim is examined. R.E.P.

A92-53434

JAPAN PUSHES HIGH SPEED RESEARCH

MICHAEL A. DORNHEIM Aviation Week & Space Technology (ISSN 0005-2175), vol. 137, no. 7, Aug. 17, 1992, p. 48-57.

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An overview is presented of Japan's effort to simultaneously improve its technology base, learn how to jointly develop complex systems, and also calm foreign criticism of a one-way flow of technology into the country. Attention is given to program activity toward future SST/HST developments for both vehicles and propulsion systems. Consideration is given to high-performance materials research and Japan's evaluation of the high speed civil transport market. R.E.P.

A92-53673

POLAR PATROL BALLOON EXPERIMENT DURING 1991-1993

T. HIRASAWA, M. EJIRI, N. SATO, R. FUJII, H. MIYAOKA, A. KADOKURA (National Institute of Polar Research, Itabashi, Japan), J. NISHIMURA, N. YAJIMA, T. YAMAGAMI (Institute of Space and Astronautical Science, Sagami, Japan), S. KOKUBUN (Tokyo, University, Japan) et al. IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1593-1597. refs

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Several Japanese research agencies have collaborated toward the development of a Polar Patrol Balloon (PPB) with a view to the establishment of a stratospheric station network over the Antarctic region for astrophysical and geophysical observations. PPB experiments are scheduled for 1991-1993, based at Syowa Station; the distinctive character and advantages of these experiments are noted for magnetic field, auroral X-ray, and stratospheric minor constituents. O.C.

A92-53675

TRANS-OCEANIC FLIGHT OVER EAST CHINA SEA - SUMMARY OF THE THREE YEARS JOINT BALLOON PROJECT BETWEEN JAPAN AND CHINA

JUN NISHIMURA, HIROMITSU AKIYAMA, SHIGEO OHTA,

01 AERONAUTICS (GENERAL)

MASAMI FUJII, YORIJI OKABE, YUKIHIKO MATSUZAKI (Institute of Space and Astronautical Science, Sagami-hara, Japan), MANABU YAMANAKA, HARUTO HIROSAWA, MICHIOYOSHI NAMIKI, and NOBUYUKI YAJIMA (Kyoto University, Uji, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1607-1612. refs

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An overview is presented for a Sino-Japanese balloonborne astronomical and atmospheric instrumentation research project conducted during 1986-1988. Attention is given to the flight performance of the seven balloons that successfully reached China from Japan and were recovered undamaged, as well as to the specific instrumentation with which the observations of X-ray stars, diffuse Galactic IR emissions, stratospheric NO density, and high-density cosmic-ray electrons were made. O.C.

A92-56001

AIRCRAFT SYMPOSIUM, 29TH, GIFU, JAPAN, OCT. 7-9, 1991, PROCEEDINGS

Symposium sponsored by Japan Society for Aeronautical and Space Sciences and Japan Aeronautical Engineers Association. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, 597 p. In Japanese. For individual items see A92-56002 to A92-56055, A92-56057 to A92-56121.

Various papers on aerospace technology are presented. Among the topics addressed are: analysis and test of low aspect wing gust load elevation, automation of emergency landings for helicopters, A320 flight control from the pilot's point of view, new techniques in missile guidance and control, application of fuzzy control to aircraft guidance, maneuvering tests of an ACV model, configuration of flexible skirts for an ACV and its CAD, potential flow theory of 2D bifurcated curtain jets, midcourse guidance study on a future autonomous tactical missile, sensitivity analysis for structural optimization of helicopter rotor blades, composite hingeless hub for rotary wing aircraft. Also considered are: pilot simulation for BK117 FBW demonstrator, development of the B777, operational status of automated aircraft washing system, aircraft satellite communication system, satellite data link for oceanic ATC, space environment resistance of CFRP for use in space infrastructure, development of aircraft bonded structure and the NDI method, polymer matrix composite for fireproof panels, state of the art materials for future gas turbine engines, properties of superplastic 7475 Al alloy 'T5'. C.D.

A92-56080

WORKING TOGETHER IN THE DEVELOPMENT OF THE B777

H. HAYASHI (All Nippon Airways, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 358-361. In Japanese.

The Boeing-777 integration system and the structure of the design build team both in the United States and in Japan for comanufacturing in 1996 are presented. Attention is given to the B777 steering committee. Y.P.Q.

A92-56083

AUTOMATIC FUNCTION TESTING IN THE AIRCRAFT PRODUCTION

HIROMICHI TAKEDA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 370-373. In Japanese.

Introduction is presented of the helicopter's Automatic Function Tester that we developed recently as an example of automated function testing for aircraft. An overview of proceeding or future task of automating at function testing in the process of aircraft production is given. Author

A92-56085

CURRENT REPAIR TECHNOLOGIES FOR JET ENGINE COMPONENTS

SHOJU MASAKI (Ishikawajima-Harima Heavy Industries Co., Ltd.,

Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 378-381. In Japanese.

The main jet engine maintenance and repairing methods are presented. The welding technology and thermal spring method are addressed, and cleaning methods for jet engine components, such as plastic blast, water jet, and ion cleaning, are discussed. Y.P.Q.

A92-56087

THE OPERATIONAL STATUS OF AUTOMATED AIRCRAFT WASHING SYSTEM

TOMOKATSU SOGA (Japan Airlines Co., Ltd., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 394-397. In Japanese.

The performance and configurations of an automated aircraft washing facility are presented. The brushing area, the operation time, and rinsing are controlled in this computerized washing system. Y.P.Q.

A92-56095

THE TECHNOLOGY OF CFRP CO-CURED WING BOX STRUCTURE FOR THE NEXT GENERATION FIGHTER. I

YUJI NORITAKE (Japan Defense Agency, Technical Research and Development Institute, Tokyo), TAMON IKEDA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and TUNENORI HOSHI (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 432-435. In Japanese.

This paper describes the technology of CFRP cocured wing box structure for next generation fighter. The Technical Research and Development Institute carried out the study of the design, manufacturing, and evaluation method for CFRP cocured wing box structure, including the full scale model testing. As the results of these studies, it was shown that all applied methods for the technology assessment of CFRP cocured wing box structure were valid. Author

A92-56096

THE TECHNOLOGY OF CFRP CO-CURED WING BOX STRUCTURE FOR THE NEXT GENERATION FIGHTER. II

YUJI NORITAKE (Japan Defense Agency, Technical Research and Development Institute, Tokyo), KAZUO OGASAWARA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and HARUYOSHI SAIGOKU (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 436-439. In Japanese.

The co-cured composite wing box structure for the next generation fighter has been developed. A manufacturing procedure, tooling concept, and NDI method have been established for the fighter wing requirements. C.D.

A92-56100

DEVELOPMENT OF AIRCRAFT BONDED STRUCTURE AND THE NDI METHOD

AKIRA YAMANASHI (Japan Airlines Co., Ltd., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 454-457. In Japanese.

Boeing aircraft bonded structures, such as aluminum honeycomb and glass fiber reinforced plastic honeycomb, are presented. The honeycomb bond inspection system is described, and the nondestructive inspection method is addressed. Y.P.Q.

N92-12991# General Accounting Office, Washington, DC. National Security and International Affairs Div.

AEROSPACE PLANE TECHNOLOGY: RESEARCH AND DEVELOPMENT EFFORTS IN JAPAN AND AUSTRALIA

Oct. 1991. 153 p

(AD-A241641; GAO/NSIAD-92-5) Avail: CASI HC A08/MF A02

02 AERODYNAMICS

U.S. leadership and preeminence in the research and development of aerospace plane technologies are being challenged by Japan and other countries. U.S. leadership and preeminence are based on the National Aero-Space Plane Program. As discussed in our prior report on European aerospace plane technology, congressional supporters of the program are concerned about foreign competition and its impact on U.S. technological leadership. The former Chairman of the House Committee on Science, Space, and Technology asked GAO to identify indicators to measure foreign countries' current state of aerospace plane technological development and progress. The indicators were selected based on the interests of Committee representatives and on discussions with experts. These indicators are (1) space policies and aerospace goals and objectives; (2) aerospace plane program objectives, design goals, schedules, and costs; (3) the current status and rate of progress in the development of critical technologies; (4) the funding for and the number and type of people involved with the programs; (5) test facilities and their capabilities; and (6) the existence of and interest in international cooperation. The former Chairman also asked GAO to collect data and information on the indicators. GRA

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A92-12423

A NUMERICAL SIMULATION OF SEPARATED FLOWS AROUND BODIES

SHIGERU ASO and ATSUHIRO SAKAMOTO Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Aug. 1991, p. 249-255. In Japanese. refs

Dynamic stall phenomena have been investigated numerically by solving incompressible Navier-Stokes equations by a third-order upwind scheme in order to reveal the flow structure and mechanism of dynamic stall. At first, in order to examine the validity of the calculations separated flows around circular cylinder are calculated. The results show excellent agreements with the experiments. Also, separated flows around a wing section at fixed attack angle are calculated and the results show excellent agreements with experiments which are conducted by the present authors. Finally, separated flows around oscillating airfoil in pitch are calculated by using moving mesh system. The flow conditions are selected from the experiments. The calculated separated region is small in pitching-up process and it becomes large in a pitching-down process. Quite different characteristics of flow patterns between a pitching-up and pitching-down processes are obtained. Author

A92-12424

A STUDY ON THE INTERACTION BETWEEN A BOW SHOCK WAVE GENERATED BY A BLUNT BODY AND A TURBULENT BOUNDARY LAYER

SHIGERU ASO, SHIGEHIDE NAKAO, SYOÛZOU MAEKAWA, KAZUO ARASHI, KENJI TOMIOKA, and HIROYUKI YAMAO Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Aug. 1991, p. 257-263. In Japanese. refs

An interaction between a bow shock wave generated by a blunt body and a turbulent boundary layer have been investigated experimentally in order to reveal the complicated flowfields of 3D shock wave/turbulent boundary layer interaction. Experiments have been conducted under the conditions of freestream Mach number of 3.83, total pressure of 1.2×10^6 Pa and Reynolds number of 2.8×10^7 with almost adiabatic wall conditions. In the experiments, a blunt body model is set above a flat plate model and a bow shock wave generated by the blunt body model impinges on a turbulent boundary layer on the flat plate. The various values of the gap between the blunt body and the flat plate are tested in

the experiments, and the effects of the gap on the interacting flowfields are studied. The results show that the effects of the gap are quite remarkable and the interaction region reduces as the gap is increased. Author

A92-14031

STEP RESPONSE OF UNSTEADY AERODYNAMICS ACTING ON A PLANE SWEEPED WING IN INCOMPRESSIBLE FLOW FOR FINITE STATE MODELING

SHINJI SUZUKI and KOSYU KADOTA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 478-484. In Japanese. refs

The approximation of unsteady aerodynamic forces acting on a plane swept wing in the time domain is considered. Time responses of the aerodynamic forces caused by a step movement of a wing in incompressible flow are calculated using the time-domain vortex element method. It was found that transient characteristics of the step responses associated with a certain generalized aerodynamic force can be represented by one decreasing function regardless of wing motions. By approximating each decreasing function with a set of exponential functions and by calculating apparent mass coefficients and steady state forces, a mathematical model for the aerodynamic forces in the form of first-order linear time-invariant differential equations (the state equations) is obtained. The accuracy and the applicability of the method have been confirmed through the comparison between the approximated aerodynamic forces and the unsteady forces calculated directly in the time-domain or measured experimentally. Author

A92-14033

FINITE DIFFERENCE NUMERICAL PREDICTION OF AERODYNAMICS OF AN AIRFOIL FLYING OVER WAVY WALL

KYOKO NITTA, SHIGENORI ANDO, and HIROYUKI WAKU Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 491-495. In Japanese. refs

The lift on an airfoil flying over a wavy wall surface is calculated using a finite difference method which was developed by Nakamichi to improve LTRAN2 evolved by Ballhaus and Goorjian. Numerical computations include cases of a flat plate over a flat solid wall prior to the cases of a moving wavy wall. Modification of grid generating system is the major point for applying the LTRAN2 version to the present problem. Weak compressibility is considered but nonlinearity is neglected in the calculations. The calculated results are compared with those obtained by the lifting surface theory of Ichikawa et al. The agreement is quite satisfactory. Author

A92-15327

TRANSIENT AERODYNAMIC BEHAVIOURS ASSOCIATED WITH STEPWISE INCIDENCE VARIATION OF AIRFOILS

Y. AIHARA, H. KOYAMA, E. AKASHI (Tokyo, University, Japan), and HUIZHONG YAO (Nanjing Aeronautical Institute, People's Republic of China) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 99-103. refs

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Transient aerodynamic characteristics of airfoil are important for the safety of airplanes, the development of helicopter rotors, and many other applications of unsteady aerodynamics. For a better understanding of these phenomena, it is necessary to investigate the simultaneous relation between the characteristics and the flowfield. The purpose of the present study is to clarify experimentally the fundamentals of the aerodynamic behaviors associated with stepwise incidence variations from 0 to some certain values, including high angles of attack, of symmetric airfoils at low speeds, Reynolds number of the order of 10^5 . Temporal variations of surface pressure distribution, lift, drag and pitching moment, and the observations of the flowfield are discussed. Author

A92-15331

SEPARATED FLOW AROUND BENT-NOSE BICONIC IN HYPERSONIC FLOW

N. ARAI, S. SAKAGUCHI (Tokyo Noko University, Koganei, Japan), Y. WADA, and S. OGAWA (National Aerospace Laboratory, Chofu, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 126-132. refs
Copyright

The article investigates the separated flow around the bent-nose biconic, in which the second ordered total-variation-diminishing (TVD) method is applied. The governing equation is a thin-layer Navier-Stokes equation. The surface-pressure distribution at the leeward side is a little higher in the vicinity of the symmetrical plane. This seems to be caused by the development of the vortex at the leeward side due to the separated flow. The location of a separation line and the size are in agreement with experiment. Also, the secondary separation is captured clearly. Author

A92-15356

COMPUTATION OF THE POTENTIAL FLOW THROUGH CASCADES USING THE CONFORMAL MAPPING AND THE SINGULARITY METHOD

SHUJI TANAKA, SUSUMU MURATA (Toyota Technological Institute, Nagoya, Japan), and KAZUO KURATA (Yanmar Diesel Co., Ltd., Osaka, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 423-430. refs
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A numerical analysis of a 2D incompressible potential flow through cascades of airfoils with arbitrary profiles is presented. An airfoil row in the physical plane is first transformed into a near-circle row using a simple mapping function, and then the singularity method is applied in the mapped plane. A cascade of thin or practical airfoils can be transformed into a near-circle row with sufficiently smooth contour through the proposed procedure. The results are found to be in good agreement with the exact solutions for a cascade of flat plates or specified airfoils by Gostelow, in which the numerical error for the typical cascade configuration is as low as 0.2 percent. O.G.

A92-15359

FLOW UNSTEADINESS BY WEAK NORMAL SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION IN INTERNAL FLOW

HEUY-DONG KIM, KAZUYASU MATSUO, SHIGETOSHI KAWAGOE (Kyushu University, Fukuoka, Japan), and TETSUHIKO KINOSITA (Toshiba Corp., Yokohama, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 457-465. refs
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The unsteadiness caused by the interaction of a weak normal shock wave with a turbulent boundary layer in a supersonic diffuser was investigated experimentally. It is found that the intermittent feature of the unsteady shock motion is similar to that in external flows and that the maximum standard deviations correspond to points where the intermittency factor approaches 0.5 and are significantly influenced by the flow separation. It is shown that far downstream from the shock wave/turbulent boundary layer interaction region the amplitude of pressure fluctuations is nearly independent of the flow Mach number. O.G.

A92-15487

REALIZATION OF A LARGE-SCALE TURBULENCE FIELD IN A SMALL WIND TUNNEL

HIDEHARU MAKITA (Toyoashi University of Technology, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 8, Oct. 1991, p. 53-64. refs
Copyright

An active turbulence generator was developed to generate a large-scale turbulence having large turbulence Reynolds numbers in a small wind tunnel. The statistical quantities were measured in the resultant homogeneous and quasi-isotropic turbulence. High turbulence intensities and large integral scales were attained in it. The energy spectrum had a wide inertial subrange of about two

orders of magnitude in wavenumber. The width of the inertial subrange approached that obtained for the grid turbulence having a far larger mesh Reynolds number of 2.4×10^6 . Intermittency of fine-scale turbulent eddies was observed in the waveform of the velocity derivative. Author

A92-15554

THREE-DIMENSIONAL FLOW AND MIXING IN A AXIAL FLOW COMPRESSOR WITH DIFFERENT ROTOR TIP CLEARANCES

AKIRA GOTO (Ebara Research Co., Ltd., Fujisawa, Japan) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 11 p. Research supported by Rolls-Royce, PLC and Ebara Corp. refs
(ASME PAPER 91-GT-89)

The effect of difference in rotor tip clearance on the mean flow fields and unsteadiness and mixing across a stator blade row were investigated using hot-wire anemometry, pressure probes, flow visualization and the ethylene tracer-gas technique on a single stage axial flow compressor. The structure of the three-dimensional flow fields was discussed based on results of experiments using the 12-orientation single slanted hot-wire technique and spectrum analysis of velocity fluctuation. High-pass filtered measurements of turbulence were also carried out in order to confirm small-scale velocity fluctuation which is more realistically referred to as turbulence. The spanwise distribution of ethylene gas spreading, estimated by the measured small-scale velocity fluctuation at the rotor exit, agreed quite well with that which was experimentally measured. This fact suggests the significant role of turbulence, generated within the rotor, in the mixing process across the downstream stator. The value of the maximum mixing coefficient in the tip region was found to increase linearly as the tip clearance became enlarged, starting from the value at midspan. Author

A92-15610

UNSTEADY LIFTING SURFACE THEORY FOR A ROTATING TRANSONIC CASCADE OF SWEEPED BLADES

HIDEKAZU KODAMA (Ishikawajima-Harima Heavy Industries, Tokyo, Japan) and MASANOBU NAMBA (Kyushu University, Fukuoka, Japan) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 12 p. refs
(ASME PAPER 91-GT-178)

A lifting surface theory is developed to predict the unsteady three-dimensional aerodynamic characteristics for a rotating transonic annular cascade of swept blades. An improved method is used to solve the integral equation for the unsteady blade loading. Numerical examples are presented to demonstrate effects of the sweep on the blade flutter and on the acoustic field generated by interaction of rotating blades with a convected sinusoidal gust. It is found that, in the case of transonic rotors, the magnitude of total aerodynamic work due to the blade vibration is reduced at large sweep angles, however blade sweep is not beneficial for noise reduction. Author

A92-15637

UNSTEADY NAVIER-STOKES SIMULATION OF TRANSONIC CASCADE FLOW USING AN UNFACTORED IMPLICIT UPWIND RELAXATION SCHEME WITH INNER ITERATIONS

M. FURUKAWA, T. NAKANO, and M. INOUE (Kyushu University, Fukuoka, Japan) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. refs
(ASME PAPER 91-GT-223)

An implicit upwind scheme is developed for Navier-Stokes simulations of unsteady flows in transonic cascades. The two-dimensional, Reynolds-averaged Navier-Stokes equations are discretized in space using a cell-centered finite-volume formulation and in time using the Euler implicit method. The inviscid fluxes are evaluated using a highly accurate upwind scheme based on a TVD formulation with the Roe's approximate Riemann solver, and the viscous fluxes are determined in a central differencing manner. The algebraic turbulence model of Baldwin and Lomax is employed. To simplify grid generations, a zonal approach with a composite

02 AERODYNAMICS

zonal-grid system is implemented, in which periodic boundaries are treated as zonal boundaries. A time-linearization of the inviscid fluxes evaluated by the Roe's approximate Riemann solver is presented in detail. No approximate factorization is introduced, and unfactored equations are solved by a pointwise relaxation method. To obtain time-accurate solutions, 30 inner iterations are performed at each time step. Numerical examples are presented for unsteady flows in a transonic turbine cascade where periodic unsteadiness is caused by the trailing-edge vortex shedding.

Author

A92-17196

EULER FLOW ANALYSIS OF TURBINE POWERED SIMULATOR AND FANJET ENGINE

NAOKI HIROSE, KEISUKE ASAI (National Aerospace Laboratory, Tokyo, Japan), RYUMA KAWAMURA (Nihon University, Funabashi, Japan), and KATUYA IKAWA. *Journal of Propulsion and Power* (ISSN 0748-4658), vol. 7, Nov.-Dec. 1991, p. 1015-1022. Previously cited in issue 18, p. 2755, Accession no. A89-42063. refs
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A92-17501

CFD APPLICATION TO 2D/3D FLOW FIELDS IN SCRAMJET ENGINE

TOSHIRO FUJIMORI, MASAFUMI KAWAI, TAKAKO SUZUKI, YASUNORI ANDO, and YASUNORI OHMORI. *Ishikawajima-Harima Engineering Review* (ISSN 0578-7904), vol. 31, July 1991, p. 221-226. In Japanese. refs

CFD plays a major role in the research and development of hypersonic flight vehicles on the premise that numerical approaches provide simulations of various conditions, including supersonic combustion for which no ground test capability exists. The 2D/3D CFD codes have been developed to simulate the supersonic/hypersonic turbulent reacting flow in supersonic combustion ramjet (Scramjet) engines. The TVD scheme is used to capture shocks, and a finite reaction-rate mode of hydrogen-air combustion is utilized. The current results for the components of Scramjet engines are presented; i.e., inlet, combustor and nozzle by using the CFD codes. Validation of these results are compared with existing experimental and computational results. Author

A92-17502

SUPERSONIC INLET FLOW COMPUTATION

SHIN-ICHI KURODA. *Ishikawajima-Harima Engineering Review* (ISSN 0578-7904), vol. 31, July 1991, p. 227-229. In Japanese. refs

Supersonic inlet plays the role of partial or whole air-compression process in supersonic/hypersonic air-breathing engines and is a key factor of the engine performance. The ultimate purpose of the present study is to clarify the complex supersonic inlet flow structure by using the computational fluid dynamics (CFD) and thereby contribute to the development of the inlet. In the present paper, a preliminary computation is performed for the flowfield about the experimental inlet model which is designed at Mach number 3.0 and has a bleed chamber. To handle the complex body configuration, a zonal method with slightly overlapped grid is adopted. The Fortified Navier-Stokes approach is used as the interface scheme, which connects each zone with high accuracy and permits the movement of discontinuities across the zonal boundary. Author

A92-17880

RADIATIVE HEAT TRANSFER FROM HYPERSONIC, NON-EQUILIBRIUM SHOCK LAYERS GENERATED UNDER REENTRY CONDITIONS

AKIHIRO SASOH, XIN-YU CHANG, TOSHIYUKI MURAYAMA, and TOSHI FUJIWARA. *Japan Society for Aeronautical and Space Sciences, Journal* (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 531-538. In Japanese. refs

Numerical analyses have been conducted on radiative heat transfer from hypersonic, nonequilibrium air shock layers over a reentry body. The band method developed here enables one to conduct wavelength-dependent, 3D radiative transfer calculation

in which self-absorption effect is taken into account. The radiative heat transfer calculated was found comparable with the case. Atomic species and $N_2(+)$ were found to be dominant radiators. Electrons play an essential role in determining radiative emission power. Due to a high electron temperature, a peak in emission power exists immediately behind the shock. At a high Mach number, since electron density is at a high level, another peak appears near the wall, enhancing the radiative heat transfer at the stagnation point and enlarging the half-width of the radiative heat flux to the wall. Author

A92-21718

EFFECTS OF GAS-SURFACE INTERACTION MODELS ON AERODYNAMIC CHARACTERISTICS

KAZUTO KUZUU and HIROTOSHI KUBOTA (Tokyo, University, Japan) (ICAS, Congress, 17th, Stockholm, Sweden, Sept. 9-14, 1990) *Japan Society for Aeronautical and Space Sciences, Transactions* (ISSN 0549-3811), vol. 34, Nov. 1991, p. 109-120. refs

This paper describes an attempt at choosing and adopting a few gas-surface interaction models in calculating aerodynamic characteristics and heating within a transition regime of rarefied gas flows. A hypersonic rarefied gas flow around a two-dimensional cylinder is solved by the method of Direct Simulation Monte Carlo (DSMC). Two kinds of gas-surface interaction models are adopted with nonequilibrium chemical reactions and relaxation of rotational energy taken into account. The first gas-surface interaction model shows a scattering of gas molecules on the body surface, while a full diffuse reflection model and a lobular reflection model are set up as the reflection models. The second model explains accommodation of rotational energy, which is contained in a diatomic molecule. The degree of the effects of each interaction model is shown from the results of the calculation. Author

A92-21722

ANALYSIS OF CIRCULAR ELASTIC MEMBRANE WINGS

TAKESHI SUGIMOTO (Tokyo, University, Japan) (*Japan Society for Aeronautical and Space Sciences, Journal*, vol. 39, no. 447, 1991, p. 180-187) *Japan Society for Aeronautical and Space Sciences, Transactions* (ISSN 0549-3811), vol. 34, Nov. 1991, p. 153-166. Translation. Research supported by MOESC. Previously cited in issue 16, p. 2667, Accession no. A91-40472. refs

A92-21985

NAVIER-STOKES CODE DEVELOPMENT FOR TRANSONIC FLOW SIMULATIONS

H. NAGASU (National Aerospace Laboratory, Tokyo, Japan) and K. FUJII (Institute of Space and Astronautical Science, Sagamihara, Japan) IN: *Computational methods in viscous aerodynamics*. Amsterdam, Netherlands and New York/Southampton, England, Elsevier/Computational Mechanics Publications, 1990, p. 273-300. refs

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Research Activities on the Computational Fluid Dynamics at the National Aerospace Laboratory are described. Emphasis is laid on the code development for the viscous transonic flow simulations. Computational algorithms used in these simulations are briefly described. Then, the developed computer codes that solve the 'Reynolds averaged' Navier-Stokes equations and their applications are reviewed. Computational examples vary from the flow simulation over a transport aircraft configuration to the flow simulation in cascades and nozzles. Recent effort for the simulation of unsteady transonic flow is also presented. Several computational methods that can handle complex configurations that have been developed lately are described with the future possibilities. The supporting computer system is also described. Author

A92-22519

THE PROBLEM OF TRANSITION FROM CONTINUUM TO RAREFIED GAS FLOWS

MICHIRO YASUHARA. *Japan Society for Aeronautical and Space Sciences, Journal* (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 1-8. In Japanese. refs

The transition from continuum to rarefied gas flows and supersonic flows around a flat plate is examined. The direct simulation Monte Carlo and total variation diminishing methods are discussed. Pressure distributions on a circular cylinder at hypersonic Mach numbers in the range between continuum flow and free molecular flow are described. Y.P.Q.

A92-22521

MINIMUM INDUCED DRAG OF A WING IN A CIRCULAR OPEN WIND TUNNEL

YUZO YAMAMOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 23-27. In Japanese. refs

The aerodynamic characteristics of a straight wing lying on a diameter in a circular open wind tunnel are studied, where minimum induced drag is assumed. In a previous work, exact expressions of spanwise optimum lift distribution and minimum induced drag were obtained from Trefftz plane flowfield analysis, where an independent variable transformation and Soehngen's inversion integral formula were used. In the present study, an alternative analysis is done, where a conformal mapping and Soehngen's formula are used. The results obtained agree with those of the previous work. Author

A92-22524

AERODYNAMIC CHARACTERISTICS OF A WING NEAR ITS TIP USING PANEL METHOD

JANG-SOO CHOI and YOSHIYUKI SUGIYAMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 45-53. In Japanese. refs

The aerodynamic characteristics around a wing tip are investigated with a first-order panel method. The geometry chosen for the study is a rectangular wing of aspect ratio 8.43, with RAF6 airfoil of 10-percent thickness ratio. The panel method gives similar aerodynamic characteristics to experimental ones even near the tip, such as very low pressure distribution near the trailing edge around the tip, and increase in local lift and drag at the very narrow region of the tip. These properties are caused by the strong spanwise velocity component around the wing tip, the inviscid effects of which are described in detail with respect to pressure coefficient, local lift and drag coefficients, downwash, and vorticity on the wing. Author

A92-22635

COMPUTATIONAL AERODYNAMIC SIMULATION ON HOPE

SIGEAKI NOMURA, YUKIMITU YAMAMOTO, SUSUMU TAKANASHI, SATORU OGAWA, MITUNORI YANAGIZAWA, and TOSHIO AKIMOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 596-603. In Japanese. refs

Research and development on the aerodynamic design of HOPE (H-II Orbiting Plane) is presented. Numerical simulation of hypersonic flow around a spaceplane is discussed. Y.P.Q.

A92-22636

AERODYNAMIC STUDY OF HOPE (H-II ORBITING PLANE)

TETSUICHI ITO, TOSHIO AKIMOTO, NORIO SUZUKI, OSAMU KOBAYASHI, KOICHI HOZUMI, SEIZO SAKAKIBARA, and IWAOKAWAMOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 604-608. In Japanese. refs

The requirements of aerodynamic design for HOPE are discussed, including heat resistant materials. Results of wind tunnel testing are analyzed, and improvements to the airframe shape and hypersonic aerodynamics are proposed. Y.P.Q.

A92-25506

ANALYSIS OF A 2-D AIRFOIL MOTION FLYING IN-PROXIMITY-TO A WAVY-WALL SURFACE-LIFTING SURFACE-SCHEME

SHIGENORI ANDO, TETSU SAKAI, and KYOKO NITTA Japan Society for Aeronautical and Space Sciences, Journal (ISSN

0021-4663), vol. 39, no. 455, 1991, p. 680-685. In Japanese. refs

An analysis of a 2D thin airfoil motion is presented for cases when it flies over and in proximity to a wavy-wall surface in an incompressible inviscid flow. Lifting surface technique is used. The results of computation agree satisfactorily with ones of another scheme, which is based on a finite difference method. Efficient integral domain on the wall surface is carefully settled. Some computations are included which suggest the effect of many parameters on WIG seaworthiness. Author

A92-25738#

NON-PLANAR WING DESIGN BY NAVIER-STOKES INVERSE COMPUTATION

T. KAIKEN, J. OGINO (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), and S. TAKANASHI (National Aerospace Laboratory, Tokyo, Japan) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 9 p. refs (AIAA PAPER 92-0285) Copyright

A three-dimensional transonic nonplanar wing aerodynamic design method is developed by combining Navier-Stokes analysis code with existing inverse code. The inverse code is based on small disturbance equation. The present method is an iterative procedure of the Navier-Stokes analysis code and the inverse code. Transonic nonplanar wing is designed for H-II Orbiting Plane (HOPE) tipfin configuration by using the present method. Such a huge tipfin, wing and body create complicated corner flow and associated separation so that it is difficult to design nonplanar wing by using conventional full potential analysis without considering the viscous effect. Navier-Stokes analysis makes it possible to design it and solve aerodynamic problems. Therefore, the method is proved to be an effective tool in aerodynamic design about a nonplanar wing. Author

A92-26410

FLOW PAST A SPHERE - TOPOLOGICAL TRANSITIONS OF THE VORTICITY FIELD

SUSUMU SHIRAYAMA (Institute of Computational Fluid Dynamics, Tokyo, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, Feb. 1992, p. 349-358. Previously cited in issue 21, p. 3290, Accession no. A90-45916. refs Copyright

A92-26797

THEORETICAL STUDY ON THE UNSTEADY AERODYNAMIC CHARACTERISTICS OF AN OSCILLATING CASCADE WITH TIP CLEARANCE (IN THE CASE OF LOADED CASCADE)

TOSHINORI WATANABE (Tokyo University of Agriculture and Technology, Koganei, Japan) and SHOJIRO KAJI (Tokyo, University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, Feb. 1992, p. 38-45. refs Copyright

In this paper, the analytical method developed previously for oscillating cascades was refined to deal with cascades with steady aerodynamic loading. The unsteady aerodynamic force acting on the linear oscillating cascades with tip clearance was calculated numerically by means of a vortex lattice method. Tip vortices were assumed to consist of linear vortex segments, and their paths were determined on the basis of experimental results measured using a 5-hole Pitot tube. The calculated damping forces showed good agreement with the corresponding experimental data. The effect of tip clearances on the flutter boundary was also investigated, and it was revealed that the cascade flutter was suppressed owing to the presence of tip clearances. When the blade oscillation was destabilized, it was found that the unsteady aerodynamic force became the exciting force at the blade-tip side sooner than at the hub side. Author

A92-29517

ANALYSIS OF A 2-D AIRFOIL MOTION FLYING IN-PROXIMITY-TO A WAVY-WALL SURFACE - FINITE DIFFERENCE METHOD

02 AERODYNAMICS

KYOKO NITTA and SHIGENORI ANDO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 457, 1992, p. 85-91. In Japanese. refs

The lift on an airfoil flying over a wavy wall surface is calculated using a finite difference method, which was developed by Nakamichi (1984) to improve LTRAN2 evolved by Ballhaus and Goorjian (1977). In order to apply this LTRAN2 version to the present problem, some manipulation on grid-making-system is needed. First, cases of a flat plate over a flat solid wall are calculated to check the coding prior to the cases of a moving wavy wall. Second, aerodynamic characteristics of a flat plate over a moving wavy wall are calculated, and third, its motion is investigated. The calculated results are compared with those obtained by the lifting surface theory. The agreements are quite satisfactory. Author

A92-29521 ERROR CHARACTERISTICS OF A VORTEX PANEL METHOD IN TWO-DIMENSIONAL FLOW

AKIO ICHIKAWA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 457, 1992, p. 119-126. In Japanese. refs

A numerical investigation is performed on the error analysis of a vortex panel method in the 2D flow. The method uses step or linear vortex distributions on straight line elements. The airfoil is divided into a set of elements by three ways: semicircular method, equispaced method, and quartercircular method. The following results are obtained: (1) the location of the optimum control point is the center of the elements for the step vortex distributions and the edge for the linear vortex distributions; (2) for dividing the way of the airfoil, the semicircular-method is the best which is followed by the quartercircular method and then by the equispaced method; (3) when the airfoil is divided by the best way, the accuracy of the solution is first order in the element size for the step vortex distributions and is second order for the linear vortex distributions. Author

A92-30502 OBSERVATION AND TESTING ON SUPERSONIC MULTIPHASE FLOW

MICHIO NISHIOKA (Osaka Prefecture University, Sakai, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. S-6 to S-14. In Japanese. refs

The development of supersonic combustion engines is presented. The convective Mach number is used and supersonic multiphase flow mixing control is discussed. A series of flow visualization images is presented. Y.P.Q.

A92-30504 NUMERICAL SIMULATION OF HYPERSONIC RAREFIED GAS FLOW AROUND A REENTRY SPACECRAFT

TORU SHIMADA (Nissan Motor Co., Ltd., Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 2-5. In Japanese. refs

The direct simulation Monte Carlo method is used as a mathematical model to study the hypersonic rarefied gas flow around a reentry spacecraft. The variable hard sphere (VHS) model and the Borgnakke-Larsen method are discussed. Y.P.Q.

A92-30505 DSMC ANALYSIS OF HYPERSONIC RAREFIED GAS FLOW

A. ITAKAKURA and HIROTO KUBOTA (Tokyo, University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 6-9. In Japanese. refs

Numerical computation of the hypersonic rarefied gas flow around an Aeroassisted Orbital Transfer Vehicle (AOTV) is presented. The null collision direct simulation Monte Carlo method is used for calculation and the molecular model of the variable hard sphere (VHS) is discussed. Y.P.Q.

A92-30517

NUMERICAL COMPUTATION OF COMPRESSIBLE FLOW AROUND AN OBJECT OF COMPLEX SHAPE

TETSU OGAWA, YASUHIRO WADA, NORIYOSHIKO ISHIGURO (Institute of Space and Astronautical Science, Sagami-hara, Japan), and HAKO TAKAKURA (Fujitsu, Ltd., Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 52-55. In Japanese. refs

Computer-aided models for the calculation of compressible flow around an object of complex shape are presented. Computational grids and the appropriate difference method are given. The total variation diminishing (TVD) scheme is emphasized. Y.P.Q.

A92-30518

COMPUTATION OF REACTING FLOWS IN CONNECTION WITH SPACE SHUTTLE RECOVERY

YASUHIRO WADA, TETSU OGAWA (Institute of Space and Astronautical Science, Sagami-hara, Japan), HIROTO KUBOTA (Tokyo, University, Japan), and HAKO TAKAKURA (Fujitsu, Ltd., Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 56-59. In Japanese. refs

A computational fluid dynamics method used in connection with the development of HOPE (H-II Orbiting Plane) is presented. The physical model of the calculation scheme is discussed, and results of the calculation are examined. Y.P.Q.

A92-30519

APPLICATION AND TESTING OF NUMERICAL SIMULATION OF HYPERSONIC FLOW AROUND HOPE

AKIRAHIRO YAMAMOTO (Institute of Space and Astronautical Science, Sagami-hara, Japan), TOSHIO AKIMOTO (NASDA, Tokyo, Japan), and ISASHIAKIRA SUZUMI (AES, Inc., Tsukuba, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 60-63. In Japanese. refs

The total variation diminishing (TVD) and the implicit approximate factorization methods are used for computing the hypersonic flow around the H-II orbiting plane (HOPE). Thermal protection design for the hypersonic velocity is discussed. The computational fluid dynamics (CFD) technologies for HOPE are described. Y.P.Q.

A92-30520

OPTIMIZED CONTROL OF STRUCTURED GRIDS

K. NAKAHASHI (Osaka Prefecture University, Sakai, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 64-67. In Japanese. refs

A computational fluid dynamics method for objects of complex shape is presented. The optimized control of marching structured grids and transverse structured grids are discussed. Y.P.Q.

A92-30522

THE UNSTRUCTURED UPWIND METHOD

EIJI SHIMA (Kawasaki Heavy Industries, Ltd., Chofu Technical Institute, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 72-75. In Japanese. refs

Numerical analysis involving the Euler equations and Navier-Stokes equations is discussed. The upwind method of the two-dimensional Euler equation for unstructured grids is examined. Unstructured mesh is also discussed. Y.P.Q.

A92-30523

MULTI-BLOCK AIRFOIL PROFILE OF GRID FORMATION

KENICHI MATSUNO (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for

Aeronautical and Space Sciences, 1990, p. 76-79. In Japanese. refs

Numerical computation for structured and unstructured grids is presented. Grid formation is discussed and transfinite interpolation techniques are addressed. A series of diagrams on airfoil profiles is presented. Y.P.Q.

A92-30526

AERODYNAMIC PERFORMANCES OF SPOILER MOTION

HIDEAKI TAKAHASHI, YASUYOSHI AIBARA (Tokyo, University, Japan), and XIEZHEN YIN (Chinese Science and Technology University, Anhui, People's Republic of China) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 92-95. In Japanese. refs

Test equipment and methods of flow visualization are presented. The distribution of spoiler motion is calculated, and the pressure distribution is determined. Y.P.Q.

A92-30527

EXPERIMENT ON PITCHING MOMENTS OF SEPARATED FLOW AROUND AIRFOIL PROFILES

SHIGERU ASO and TOKUNO KANCHIRA (Kyushu University, Fukuoka, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 96-99. In Japanese. refs

Experimental equipment and methods for investigating the pitching moments of separated flow around airfoil profiles are presented. Calculation and experimental results for the separated flow are compared. Y.P.Q.

A92-30528

AIR FLOW UNDER A FLIGHT-VEHICLE ENGINE

EIICHIRO NAKANO and HIROTO KUBOTA (Tokyo, University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 100-103. In Japanese. refs

Experimental equipment and methods for investigating the air flow under a flight-vehicle engine are presented. Schlieren photographs of the flow are presented. Y.P.Q.

A92-30530

STUDY ON TWO-DIMENSIONAL JET MIXING WITH A VERTICAL SUPERSONIC FLOW

SHIGERU ASO, TETSU OKUYAMA (Kyushu University, Fukuoka, Japan), MASAFUMI KAWAI, and SHUNRO FUJIMORI (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 108-111. In Japanese. refs

Two-dimensional jet mixing with a vertical supersonic flow is studied experimentally. The wall pressure distribution is analyzed and schlieren photographs the flow fields are presented. Y.P.Q.

A92-30531

STUDY ON NOZZLE FLOW DIFFUSION

MOTOAKIRA KIMURA and KIYOAKI ONO (Nihon University, Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 112-115. In Japanese. refs

Studies on diffusion structures from potential cores are presented. Static pressure is measured and schlieren photographs of a jet in the near nozzle region are presented. The average velocity distribution and static pressure distribution are discussed. Y.P.Q.

A92-30532

THE BAUER-GARABEDIAN-KORN AIRFOIL TEST IN A TWO-DIMENSIONAL WIND TUNNEL

S. SUYA and HIROSHI KANDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings.

Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 116-119. In Japanese. refs

Pressure distribution measurements and visualization tests are presented for tests conducted in a two-dimensional transonic wind tunnel. Schlieren photographs of the pressure distribution are presented. Y.P.Q.

A92-30538

STUDY OF CAVITY PUMPING IN SUPERSONIC INTERNAL FLOW

TETSU MURAKAMI, K. SAKATA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and FUMIO OMIYAYAMA (Tokyo, University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 140-143. In Japanese. refs

The fundamental structure of cavity pumping flows is presented. The intake slot section simulated for hypersonic flow is designed. The pressure distribution of the diffuser outlet is addressed. Y.P.Q.

A92-30539

NUMERICAL COMPUTATION OF SUPERSONIC INTAKES

SHINICHI KURODA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) and KOZO FUJII (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 144-147. In Japanese. refs

The engine air intakes for the next-generation supersonic transport are discussed. The Lu-ADI method, Roe's flux difference splitting, and the MUSCL are used for analysis of the supersonic intake. The Concorde intake inlet is considered as an example. Y.P.Q.

A92-30540

NUMERICAL SIMULATION OF SUPERSONIC NOZZLE FLOW

T. HIRATA, T. MIYAUCHI, and M. KITAJIMA (Tokyo Industrial University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 148-151. In Japanese. refs

Supersonic nozzle design is considered. The M6 axisymmetric nozzle is emphasized, and the Navier-Stokes equations are given. Y.P.Q.

A92-30541

COMPUTATION OF SCRAMJET INLET FLOW

NORIYOSHUIKO ISHIGURO, S. OGAWA, and Y. WADA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 152-155. In Japanese. refs

Scramjet engines for supersonic or hypersonic flying vehicles are presented. The Navier-Stokes equations are given for computation of the inlet flow. Y.P.Q.

A92-30542

NUMERICAL COMPUTATION AND EXPERIMENTAL STUDY OF SHOCK WAVE REFLECTION

TENRYUKI NAKAJIMA, SHIGERU ASO, and M. NISHIDA (Kyushu University, Fukuoka, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 156-159. In Japanese. refs

Investigation of shock wave reflection in connection with hypersonic flight is examined. Two-dimensional Euler equations and Piecewise Linear methods (PLM) are given for numerical computation and testing. Schlieren photographs and density contours are presented. Y.P.Q.

A92-30550

MEASUREMENT ON HYPERSONIC DYNAMIC STABLE COEFFICIENTS OF A WINGED VEHICLE

02 AERODYNAMICS

SHIGEYA WATANABE, A. YOSHINAGA, and AKIRA YOSHIKAWA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 188-191. In Japanese. refs

The measurement of dynamic stability for a flight vehicle is presented. A computational method for dynamic stability and static stability coefficients is reported. The basic mode of the pitching free vibration is discussed. Y.P.Q.

A92-30551

APPROXIMATE ANALYSIS OF AERODYNAMIC HEATING AT HYPERSONIC SPEED

KEIICHI KARASHIMA and KIYOSHI SATO (National Aerospace Laboratory, Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 192-195. In Japanese. refs

A plate thermal sensor is used in a wind tunnel test. The thermal video system TVS-2000 is presented for the measurement of the surface temperature distribution of the hypersonic flow past a plate. An algorithm for the evaluation of heat transfer is presented. Y.P.Q.

A92-30552

STUDY ON EFFECTIVENESS OF THE FRONT WEDGE SHAPE IN HYPERSONIC FLOW

TOSHIO MATSUI and ETSUO MORISHITA (Tokyo, University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 196-199. In Japanese.

A hypersonic thermal wind tunnel test for the effectiveness of the front wedge shape is presented. Schlieren photographs of spikes are presented and the drag coefficients of spikes are measured. Y.P.Q.

A92-30557

NUMERICAL ANALYSIS ON LAMINAR FLOW CONTROL OF TRANSONIC AIRFOILS

N. KAWAI and Y. ISHIDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 216-219. In Japanese. refs

The use of Navier-Stokes equations in laminar flow control theory is discussed. The boundary conditions and flow model are given and an analysis of the distribution of pressure and friction coefficients is presented. Y.P.Q.

A92-30558

NUMERICAL ANALYSIS OF HELICOPTER ROTOR BLADES

SHIGERU SAITO (Institute of Space and Astronautical Science, Sagami-hara, Japan), G. AOYAMA, and K. KAWAUCHI (Tokyo, University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 220-223. In Japanese. refs

An analysis on helicopter vortex flow is presented. The Chakravathy-Osher typed TVD scheme is used to investigate the pressure distribution on the helicopter blade tips. The blade shape design for high speed is also discussed. Y.P.Q.

A92-30559

LOW SPEED AERODYNAMIC PERFORMANCE OF A CAPSULE-SHAPED FLYING OBJECT

TADAHARU WATANUKI, H. KUBOTA, SHINICHI MIKAMI (Tokyo, University, Japan), H. SUZUKI (Institute of Space and Astronautical Science, Sagami-hara, Japan), and JUNICHI SATO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 224-227. In Japanese.

The measurement of the flow field around a capsule-shaped

flying object is presented. The duct wall pressure distribution is examined and the velocity distribution inside the duct is computed. Y.P.Q.

A92-30560

BOUNDARY LAYER FLOWS AROUND AN AIRSHIP

N. TSUBOKAWA and MITSUO MAKINO (Nihon University, Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 228-231. In Japanese. refs

Navier-Stokes analysis for boundary layer flows is presented. The Legendre equation and the Pohlhausen method are used for the outlet and inlet flows of the boundary layer. The inertia coefficient is determined from Laplace's equation. Y.P.Q.

A92-32501

NUMERICAL ANALYSIS OF THREE-DIMENSIONAL UNSTEADY TURBULENT FLOWS IN A TURBINE STAGE

YOSHIO SHIKANO and MASAHIRO IKEGAWA (Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2570-2575. In Japanese. refs

A numerical method for analyzing 3D unsteady turbulent flows in a turbine stage is described. To calculate the unsteady interaction flow fields in a nozzle and bucket simultaneously, the bucket inlet elements and the nozzle outlet elements are overlapped in the axial direction and are employed for unsteady data transfer between flow regions. It is shown that unsteady flow phenomena such as the pressure field and nozzle wake interactions are well predicted, and the periodic aerodynamic forces acting on the buckets, including the effect of the axial distance difference, are obtained. R.E.P.

A92-32504

A NUMERICAL SOLUTION OF INVISCID TRANSONIC FLOW USING THE BOLTZMANN EQUATION

KATSUYA NAKAMURA, NOBUYUKI SATOFUKA, and KOJI MORINISHI (Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2597-2602. In Japanese. refs

An efficient numerical method of the Boltzmann equation is developed for inviscid transonic flow. The convective terms in the Boltzmann equation are approximated by the second-order upwind finite difference with limiter. The rational Runge-Kutta scheme is used for the corresponding time integration. The residual averaging technique is incorporated into the method so that the rate of convergence is improved to a steady-state solution. The solution of the collision integral is obtained as thermodynamic equilibrium states. The number of grid points in molecular velocity space is reduced to 4 for each direction to shorten the CPU time in the present approach. As an example, the 1D unsteady shock-tube problem is solved and the results are compared with the exact solution. The feasibility of the present method is demonstrated for the 2D transonic flow in a channel, and over the NACA 0012 airfoil and the RAE 2822 airfoil. Author

A92-34466#

SUBCRITICAL FLUTTER CHARACTERISTICS OF A SWEPT-BACK WING IN A TURBULENT SUPERSONIC FLOW - COMPARISON BETWEEN ANALYSIS AND EXPERIMENT

HIROSHI TORII (Meijo University, Nagoya, Japan) and YUJI MATSUZAKI (Nagoya University, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 4. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1870-1877. refs (AIAA PAPER 92-2393) Copyright

Using FEM, subcritical flutter characteristics of a cantilever swept-back wing which was tested in a turbulent increasing supersonic flow are investigated. Comparison between the nonstationary analysis and the experiment shows that the variance of the estimated Jury's stability parameter of the wing in a turbulent flow decreases toward zero as the dynamic pressure approaches the flutter boundary, whereas the variance of the estimated damping

remains large. The flutter boundary is predictable by the intersection of the upper straight line of the envelope enclosing the scattered values of Jury's (1964) stability parameter with the horizontal coordinate. The flutter prediction method based on Jury's stability parameters is more effective in practical application with flow turbulence than the conventional damping method. Author

A92-35758**NAVIER-STOKES ANALYSIS OF BLADE TIP SHAPE IN HOVER**

TAKASHI AOYAMA (Tokyo, University, Japan), SHIGERU SAITO (National Aerospace Laboratory, Chofu, Japan), and KEIJI KAWACHI (Tokyo, University, Japan) European Rotorcraft Forum, 16th, Glasgow, Scotland, Sept. 18-21, 1990, Paper. 13 p. refs

The 3D Navier-Stokes equations are solved to analyze the flowfield around blade tips of hovering rotors. The eddy viscosity is calculated by employing the q - ω two-equation turbulence model developed by Coakley. An implicit finite-difference method is used to solve the equations and the algebraic method is adopted to generate the grids. The effect of wake outside of the grid is taken into calculation by correcting the equivalent geometric angle of attack along the blade radius. Its value is estimated by using Local Circulation Method. The pressure distributions of rectangular tip shape predicted by the present method are in good agreement with the experimental data. The computed results for swept or tapered tip shapes by the present NS code are compared with our Euler results at subsonic condition. Differences between the results obtained by the viscous and inviscid analyses are shown. Author

A92-35913**CURRENT TOPICS CONNECTED WITH ROTATING STALL**

HIROYUKI TAKATA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 195-201. In Japanese. refs

The characteristics of rotating stall and actuator disk theory are described. A vortex model for rotating stall is given and the velocity distribution is discussed. The coefficients of active stall control are analyzed. Y.P.Q.

A92-35995**AN ANALYTICAL EVALUATION OF THE AERODYNAMIC FORCES ACTING ON A CIRCULAR CYLINDER IN A UNIFORM SHEAR FLOW**

TSUTOMO HAYASHI, FUMIO YOSHINO, and RYOJI WAKA (Tottori University, Japan) IN: Forum on Turbulent Flows - 1991; ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991, Proceedings. New York, American Society of Mechanical Engineers, 1991, p. 83-88. refs

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In this paper, a new technical method is presented for quantitative evaluation of the lift and drag coefficients on the circular cylinder in a uniform shear flow. The displacement effect originating from a shift of the stagnation streamline, the asymmetry of the pressure distribution on the circular cylinder, and the increase in base pressure caused by differences in the turbulence intensity in the free stream, in the aspect ratio and in the blockage ratio are considered as analytical elements. It is confirmed that in using this technique for the evaluation, the lift force of the circular cylinder is always directed from the higher velocity side to the lower velocity side of the shear flow. Author

A92-35997**CHANGE OF FLOW ABOUT AN ELONGATED RECTANGULAR CYLINDER IN A RANGE OF REYNOLDS NUMBERS OF 200 TO 0.7×10^5**

ATSUSHI OKAJIMA (Kanazawa University, Japan) IN: Forum on Turbulent Flows - 1991; ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991, Proceedings. New York, American Society of Mechanical Engineers, 1991, p. 107-113. refs

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Flow characteristics for elongated cylinders with the side ratio

of 4 to 15 are measured in the relatively wide range of Reynolds numbers between 200 and 0.7×10^5 in a wind tunnel and flow around cylinders is visualized using the electrolytic-precipitation technique in a water tank. A new critical value of 6.5 of a side ratio for a rectangular cross section is seen to exist at high Reynolds numbers. The measured results of a reduction of a base pressure at the Reynolds number of approximately 500 are simulated by the computations, and a synchronization between movements of separation bubbles and a wake creates the reduction of the base pressure for the cylinders with the side ratio over six. R.E.P.

A92-36036**UNSTEADY NAVIER-STOKES SIMULATION OF TURBULENT FLOWS THROUGH A SUPERSONIC COMPRESSOR CASCADE**

SATORU YAMAMOTO and HISAAKI DAIGUJI (Tohoku University, Sendai, Japan) IN: Numerical simulations in turbomachinery; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 73-79. refs

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The purpose of the present paper is to investigate unsteady turbulent flows through a supersonic compressor cascade using the methods proposed by the authors in which efficient numerical schemes for unsteady calculation, shock capturing, and turbulent quantities are used. The numerical results calculated by the present method show that oblique shocks, normal shocks, and their induced boundary layer separations can be captured more accurately compared with ordinary numerical results, agreement with the experimental data is better. Finally, limitations of the present method for unsteady calculation are discussed. Author

A92-36038**NUMERICAL SIMULATIONS OF THE FLOW THROUGH CASCADES WITH TIP CLEARANCE**

TOSHINORI WATANABE (Tokyo University of Agriculture and Technology, Japan), OSAMU NOZAKI, KAZUO KIKUCHI, and ATSUSHI TAMURA (National Aerospace Laboratory, Tokyo, Japan) IN: Numerical simulations in turbomachinery; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 131-139. refs

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Three-dimensional flowfields through cascades with tip clearance were numerically simulated by solving the Navier-Stokes equations with LU-ADI scheme. The computational grid was generated by a zonal method. A fundamental cascade composed of flat plates was adopted to develop the appropriate solution method. The computed results showed good agreement with experimental data and the reliability of the method was verified. The detailed flow phenomena around blade tip, such as the formation of separation bubbles on tip surface, were clearly described. The method was further applied successfully to a stationary turbine, a rotating fan blade, and a rotating turbine blade. Author

A92-36357**NUMERICAL SIMULATION OF OPPOSING SONIC JETS**

H. NOMURA, S. ASO, and M. NISHIDA (Kyushu University, Fukuoka, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 229-233. refs

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This paper describes the numerical simulation of an opposing sonic jet exhausting against a supersonic free stream of Mach number 3. The flow is axisymmetric and inviscid, and the jet and free stream are composed of the same kind of gas. The numerical method employs the Harten-Yee second-order upwind TVD scheme. The numerical results have been compared with the flow visualization pictures taken by the laser-induced fluorescence

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method and satisfactorily good agreement has been obtained.

Author

A92-37549

NUMERICAL SIMULATION OF HYPERSONIC VISCOUS FLOW FOR THE DESIGN OF H-II ORBITING PLANE (HOPE)

YUKIMITSU YAMAMOTO (National Aerospace Laboratory, Chofu, Japan) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 59-72. refs
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An unmanned winged vehicle for space transportation called H-II orbiting plane (HOPE) is being studied by the National Space Development Agency of Japan (NASDA). CFD analyses have been performed for HOPE 62A, 62B, 62C, and HOPE 63 models proposed by NASDA. Through these analyses, more than 50 numerical test cases have been calculated and aerodynamic and aerothermodynamic characteristics are investigated in detail. In the study, numerical simulations have been done by using a flux split upwind Navier-Stokes code. The results showed excellent agreements with experiments for aerodynamic stability and heat transfer distributions and the validity of the present code is demonstrated.

Author

A92-38856

EFFECT OF CONTROLLED LONGITUDINAL VORTEX ARRAYS ON THE DEVELOPMENT OF A TURBULENT BOUNDARY LAYER

HIDEO OSAKA and CHI HARU FUKUSHIMA (Yamaguchi University, Ube, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 290-298. refs
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Measurement was made on the mean flowfield to investigate the development of a turbulent boundary layer interacting with controlled longitudinal vortex arrays that were artificially generated from tiny airfoils arranged side by side in the free stream. Five arrangements varying in spacing between neighboring airfoils and distance of airfoil arrays from the test wall were studied. Within the boundary layer, there is spanwise transport of streamwise momentum due to pairs of counterrotating secondary flows. As a result, a spanwise periodic variation corresponding to the spanwise arrangement of airfoil elements arises in the mean flowfield and persists in the far-downstream region. The spacing between neighboring airfoils leads to a significant effect on the streamwise path of longitudinal vortices, which significantly affect the magnitude of boundary layer distortion. Even in the present three-dimensional flowfield, the streamwise velocity profiles collapse reasonably well on the standard logarithmic law of the wall. However, the wake region of logarithmic profiles is different at representative spanwise locations.

Author

A92-38859

THE EFFECT OF A VELOCITY GRADIENT ON THE AERODYNAMIC FORCES OF A CIRCULAR CYLINDER WITH TANGENTIAL BLOWING

TSUTOMU HAYASHI and FUMIO YOSHINO (Tottori University, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 317-324. refs
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The lift and drag acting on a circular cylinder with tangential blowing immersed in a uniform shear flow are presented for a shear parameter $K = 0.15$ and Reynolds number $Re = 60,000$, and the effect of the velocity gradient of the uniform shear flow on characteristic values is discussed for coefficients of momentum of the blowing jet ranging from 0 to 0.4. The characteristic values

include the angle and the pressure coefficient of the stagnation point, separation points, minimum pressure point, and base pressure. Consequently, the shear parameter in the two cases where the location of the blowing slot on the circular cylinder is on the cylinder surface on the faster side of the shear flow ($K +$) and on the slower side ($K -$) yields the difference of coefficients of lift and drag and different starting points for the forced reattachment phenomenon. A comparison of various features such as the stagnation point clarifies the contributions of each feature to the lift and drag on the cylinder.

Author

A92-38863

EXPERIMENTS ON TURBULENT FLOW DUE TO AN ENCLOSED ROTATING DISK

MOTOYUKI ITOH, YUTAKA YAMADA, SHIGEKI IMAO, and MASAHIRO GONDA (Nagoya Institute of Technology, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 359-368. refs
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An experimental study is undertaken on the turbulent flow due to an enclosed rotating disk. Measurements of the mean velocity distributions and all six components of Reynolds stress are made for the two boundary layers developed on the rotating disk (rotor) and the stationary end wall (stator). It is revealed that the velocity distributions in the respective boundary layers show a similarity at constant local Reynolds number $Re_{sub L}$. A log-law region where the circumferential velocity profile follows the logarithmic law for the flat-plate boundary layer is observed at high $Re_{sub L}$ values. All the components of Reynolds stress normalized by the friction velocity are larger inside the stator-side boundary layer than in the rotor-side boundary layer. The directions of the shear stress vectors are found not to coincide with the directions of the velocity gradient vectors.

Author

A92-40056

THREE-DIMENSIONAL VORTICAL STRUCTURE OF A LARGE-SCALE COHERENT VORTEX IN A TURBULENT BOUNDARY LAYER

H. MAKITA and K. SASSA (Toyohashi University of Technology, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 2-2-1 to 2-2-6. refs

The streamwise evolution of three-dimensional structure of an artificially induced vortex was pursued by measuring velocity and vorticity fields through a simplified conditional sampling. The artificial vortex developed downstream through the growth, the self-preserving and the decay stages. In the growth stage, the vortex grew up to have a horseshoe sculpture and the vorticity confined in it was increased downstream. The grown-up large-scale horseshoe vortex reached about 1.2 delta in height, 1.0 delta in width, and 5.0 delta in streamwise length. The vortex became more inclined forward and lost the ability of maintaining its self-similar construction in the decay stage. The convection velocity of the vortex's head was 0.56 $U(\infty)$ in the foregoing two stages and was raised to 0.85 $U(\infty)$ in the decay stage.

Author

A92-40086

PHASE-AVERAGED TURBULENCE STATISTICS IN A NEAR WAKE WITH AN ASYMMETRIC VORTEX SHEDDING

A. NAKAYAMA (Kobe University, Japan), H. R. RAHAI, and H. UNT (California State University, Long Beach) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 9-3-1 to 9-3-6. refs

The turbulent near wake of a two-dimensional body influenced by a vortex shedding due to a fixed separation on one side has been measured by a direction-sensitive multicomponent split-film probe and the flow characteristics were studied in terms of the phase-averaged statistics of the turbulent velocity components.

The contributions to the total apparent shear stress from the periodic motion and the random fluctuation are comparable in one case, but the phase-averaged Reynolds shear stress is fairly well described by a positive eddy viscosity. Author

A92-40106**AN EXPERIMENTAL AND NUMERICAL STUDY OF CONFINED AXISYMMETRIC JET WITH A BLUFF BODY**

M. SENDA, S. OKAMOTO, and S. KIKKAWA (Doshisha University, Kyoto, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 14-1-1 to 14-1-6. refs

Results are reported from experimental and numerical studies conducted on a confined axisymmetric jet with two types of bluff bodies - a cylindrical ring and a disk, both of which have the same blockage ratio. The velocity characteristics in the near wake are measured with a laser Doppler velocimeter, the results of which are compared with the numerical calculations using the k-epsilon model of turbulence. The size of the recirculating region behind the ring was not affected by the velocity ratio U_j/U_s of the jet and the circumferential flows, whereas both the axial and radial extent of the recirculating region behind the disk became larger with increasing U_j/U_s . In the near-wake region, the positions where the values of the mean axial velocity gradient and the Reynolds shear stress were respectively at zero did not necessarily coincide, and the present flow indicates the existence of the region of the negative production. C.A.B.

A92-40119**SCRUTINIZING K-EPSILON EVM AND ASM BY MEANS OF LES AND WIND TUNNEL FOR FLOWFIELD AROUND CUBE**

S. MURAKAMI, A. MOCHIDA, and Y. HAYASHI (Tokyo, University, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 17-1-1 to 17-1-6. refs

A92-40177**EFFECTS OF ATTACK ANGLE ON LEG PORTION OF THE HORSESHOE VORTEX AROUND THE IDEALIZED WING**

T. SHIZAWA, S. HOMAMI (Tokyo, Science University, Japan), and M. YAMAMOTO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-18-1, 1-18-2. refs

The mechanism of horseshoe vortex interaction with the 2D boundary layer is investigated, and the effects of the attack angle on the leg vortex are clarified. The diffusing processes were found to depend on the distribution of Reynolds stresses at the region between plate and wing. The vortex motion of the leg vortex is largely influenced by the attack angle. P.D.

A92-40598**THE LOW-TURBULENCE WIND TUNNEL AT TOHOKU UNIVERSITY**

H. ITO, R. KOBAYASHI, and Y. KOHAMA (Tohoku University, Sendai, Japan) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 954, April 1992, p. 141-151. Research supported by MOESC. refs

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A general-purpose low-turbulence wind tunnel was constructed using the design method of Bradshaw. Sound-absorbent material was used in every four corners to decrease sound intensity produced by a fan. The longitudinal component of turbulence intensity at the center of the closed working section is less than 0.02 percent of the mean velocity in the speed range between 18 m/s and 53 m/s. The mean velocity variations across the working section are within ± 0.1 percent of the mean velocity. Performance measurements have been done at representative tunnel cross sections to clarify the behavior of flow in the tunnel. This work differs from previous studies in the sense that emphasis

is placed not only on velocity distributions, but also on turbulence intensity distribution at several cross sections of the tunnel. The critical Reynolds number for a flat plate at zero incidence, $Re(c) = 3.5 \times 10^6$, measured in a stream of the very low turbulence intensity of 0.016 percent, is larger than that reported by Schubauer and Skramstad. Author

A92-43101**EXPERIMENTAL STUDIES ON AERODYNAMIC HEATING AND THERMAL PROTECTION IN HYPERSONIC FLIGHT**

SHIGEAKI NOMURA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 48-51. In Japanese.

The aerodynamic heating distribution of the HOPE (H-II orbiting plane) and space plane are presented. The aerodynamic heating test in a shock tunnel is discussed. The thermal protection test for heat resisting tile is given and carbon/carbon composite materials for thermal protection are examined. Y.P.Q.

A92-43102**AERODYNAMIC HEATING MEASUREMENT IN HYPERSONIC FLOW**

SHIGERU ASO (Kyushu University, Fukuoka, Japan) and M. HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 52-55. In Japanese. refs

An aerodynamic heating measuring method for hypersonic flow is described. Gauge theory of the thin film heat transmission and a calorimeter method are discussed. The theory of a multilayer thin film thermal flow sensor is presented. Y.P.Q.

A92-43103**A THIN METAL MODEL FOR AERODYNAMIC HEATING TESTS OF SHOCK WAVE INTERACTION**

HIROICHI HOZUMI, AKIRA YOAHAZAWA, YASUTOSHI INOUE (National Aerospace Laboratory, Chofu, Japan), M. KAZAHARA, T. ABE, and YOSHIHARU TANAHASHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 56-59. In Japanese. refs

Shock wave interaction patterns for aerodynamic heating tests are described. The performance of the thin metal model is given and the test requirements are discussed. Test results show the effectiveness of the shock wave interaction. Y.P.Q.

A92-43119**ANALYSIS OF THE AERODYNAMIC PERFORMANCE OF ROTORS WITH THE BOUNDARY ELEMENT METHOD**

TOMOARI NAGASHIMA, H. NAKAGAWA, and GIZO HASEGAWA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 124-127. In Japanese. refs

Rotor aerodynamic performance in low-velocity flight is evaluated. The computational model for hovering is given, and inviscid flow and incompressible flow around rotors are calculated. Y.P.Q.

A92-43132**RESEARCH ON STATE EQUATIONS OF UNSTEADY AERODYNAMICS**

SHINJI SUZUKI and T. KONDO (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 176-179. In Japanese. refs

Computational methods of unsteady aerodynamics are presented. Calculations of the velocity potential on the wing surface and pressure distribution and aerodynamic coefficients are emphasized. Y.P.Q.

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A92-43144

THE MAIN WING BOUNDARY LAYER SEPARATION PATTERN OF STOL RESEARCH AIRCRAFT ASUKA

YOSHIO HAYASHI (National Aerospace Laboratory, Chofu, Japan), MASAKI SAITO, and TAKASHI INOUE (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 232-235. In Japanese.

The airflow system monitoring instrument and its recording method for the flight test of the quiet STOL research aircraft Asuka are presented. The separation pattern is illustrated and the effectiveness of engine operation state, engine power and boundary layer control (BLC) are discussed. Y.P.Q.

A92-43145

AERODYNAMIC DRAG AS DETERMINED FROM FLIGHT TEST DATA OF THE STOL RESEARCH AIRCRAFT ASUKA

MASAAKI YANAGIHARA, SHUICHI SASA (National Aerospace Laboratory, Chofu, Japan), and YOICHI TAKEI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 236-239. In Japanese. refs

The aerodynamic drag determination for the STOL research aircraft Asuka is presented. STOL landing and takeoff states data are obtained. Y.P.Q.

A92-43166

EXPERIMENTAL AND NUMERICAL INVESTIGATIONS ON SEPARATED FLOWS AROUND PITCHING AIRFOILS

SHIGERU ASO, NORIYUKI KANEHIRA (Kyushu University, Fukuoka, Japan), ATSUSHI FUJIMOTO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and MASANORI HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 326-329. refs

Separated flows around wing sections at pitching motion have been investigated experimentally and numerically. In the experiments, the unsteady flow around oscillating airfoils are visualized by a smoke wire method in order to investigate the detailed flow structure and the mechanism of the dynamic stall. In the experiments, a wing section of NACA0012, whose span is 1250 mm and chord is 250 mm, is used. The experiments are carried out under the testing conditions of freestream velocity of 4 m/s and Reynolds number of $6.8 - 7.2 \times 10^5$. The wing section is oscillated sinusoidally at reduced frequency of 0.2 with an amplitude of 4 deg around mean attack angles of 14, 16, and 18 deg. Significant changes of the extent of separated region behind a wing section at increasing and decreasing process of the attack angle are observed. The results suggest that the characteristics of dynamic stall are well captured in the experiments. In the numerical investigations, separated flow are simulated numerically by a discrete vortex method combined with a panel method. The potential flows around wing sections is expressed by vortex sheets and separated shear layers are expressed by discrete vortices. For lower mean attack angles calculated results show good agreements with experiments qualitatively. Author

A92-43169

DIRECT SIMULATION OF HYPERSONIC RAREFIED FLOWS ABOUT ATMOSPHERIC RE-ENTRY VEHICLES

TORU SHIMADA (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 338-341. refs

Hypersonic rarefied flows about atmospheric reentry vehicles (capsules) are investigated by the direct simulation Monte Carlo method combined with general body-fitted grid systems generated along with the multiblock concept. The null-collision technique is employed for collision sampling and the real air model includes the variable hard-sphere molecular model, Borgnakke-Larsen's concept of handling molecular internal degrees of freedom, and

the steric factor of Bird for chemical reactions. The obtained flowfield structure shows variations of the rarefaction effect and chemical activities with flight altitudes and body shapes. Surface pressure distribution is in fair agreement with theoretical references. Heat transfer coefficients are compared with a bridging formula, and good agreement is found for cases of a Gemini-type capsule, while disagreement is seen for cases of a blunt-cone capsule.

Author

A92-43174

DESIGN - ANALYSIS AND EXPERIMENTAL VERIFICATION OF A PROPELLER WORKING IN THE LOW REYNOLDS NUMBER RANGE

KINGO TAKASAWA and MASATAKA HASHIDATE (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 358-361. refs

An optimum propeller for a microwave-powered airplane (MPA) whose chord-based representative Reynolds number is in $1-2 \times 10^5$ range was designed according to Adkins and Liebeck's theory. In order to evaluate the theoretical prediction of both design point and off-design performance, a model propeller working in the same Reynolds number range was purposely fabricated and tested in the NAL low speed wind tunnel. Theoretical predictions are compared with test results. Thrust predictions show very good coincidence with test results. Torque predictions show fairly good coincidence. The difference between the theoretical predictions and experimental measurements is thought to be partially attributed to the shrinkage of the drag bucket in propeller blade sections, comparing with that of the two-dimensional airfoil data. The methods for aerodynamic design and off-design prediction were quantitatively established. Author

A92-43191

ANALYSIS OF THE AERODYNAMIC CHARACTERISTICS OF A SIMPLE REMOTELY PILOTED RESEARCH VEHICLE (RPRV)

AKIRA SAKURAI, CHUICHI NAKAYAMA, MANABU MATSUBARA, and NATSUKO KUDO (Kyushu University, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 428-431. In Japanese. refs

The aerodynamic model for the flight test of a simple remotely piloted research vehicle (RPRV) is presented. The data processing approach is described, and sensor configurations are discussed. Y.P.Q.

A92-43194

THE FLUID-DYNAMIC MEASUREMENT OF THE FLING MOTION OF A THREE-DIMENSIONAL FLAT PLATE

S. SUNADA, T. WATABE, and H. KAWAUCHI (Tokyo, University, Japan), and SUSUMU TAKANASHI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 440-443. In Japanese. refs

The fling and near-fling motion of a wing are observed. The requirements and configurations of the facility for this observation are given; the wing motion is recorded by a video camera. Y.P.Q.

A92-43197

AERODYNAMIC DESIGN OF A NONPLANAR AIRFOIL BY AN INVERSE METHOD WITH NAVIER-STOKES EQUATIONS

T. UMIDA, JUN OGINO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and SUSUMU TAKANASHI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 452-455. In Japanese. refs

The aerodynamic design for the primary shape of HOPE (H-II orbiting plane) is discussed. Computational grids for the HOPE airfoil and computing methods are described. A comparison of the surface pressure distribution of HOPE between the primary shape and the improved shape is presented. Y.P.Q.

A92-43198

AERODYNAMIC DESIGN TOOL DEVELOPMENT FOR THE CALCULATION CODE OF HYPERSONIC FLOW

M. NAKAO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) and KOZO FUJII (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 456-459. In Japanese. refs

The variable equivalent gamma method (VEG) is used for the analysis of hypersonic flow. The computational results are given, and pressure distribution and surface temperature distribution are evaluated. Y.P.Q.

A92-43201

BGK AIRFOIL OIL FLOW TEST IN A TWO-DIMENSIONAL TRANSONIC WIND TUNNEL

MAMORU SATO, H. KANDA, S. SAYA, and IWAO KAWAMOTO (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 468-471. In Japanese. refs

A two-dimensional transonic high Reynolds number wind tunnel test is presented. The configuration of the BGK model is discussed. Test results show the effect of the boundary layer separation on the side wall. Y.P.Q.

A92-43202

BUFFETING CHARACTERISTICS OF A TRANSONIC AIRFOIL

MAMORU SATO, H. KANDA, S. SAYA, and IWAO KAWAMOTO (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 472-475. In Japanese. refs

The nonstationary pressure and C_p distribution on an airfoil were evaluated by flow visualization. The buffeting boundary and heavy buffeting are discussed, and power spectral density functions are presented. Y.P.Q.

A92-43203

THE EFFECTIVENESS OF THE WARP SHAPE AIRFOIL OF A SUPERSONIC TRANSPORT

T. YOSHIDA and S. HAYAMA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 476-479. In Japanese. refs

A method for the design of the warp shape airfoil of a supersonic aircraft is presented. The chord pressure distribution is emphasized. The vortex lattice method (VLM) is employed. Y.P.Q.

A92-43204

EXPERIMENTAL STUDY OF THE AERODYNAMIC CHARACTERISTICS AT MACH 3 OF AN AIR-INTAKE MODEL

A. MURAKAMI, R. YANAGI, S. SHINDO (National Aerospace Laboratory, Tokyo, Japan), S. HANAMI (Tokyo, Science University, Japan), ATSUSHIGE TANAKA, and KAZUO SHIRAIISHI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 480-483. In Japanese. refs

The configurations of a supersonic intake at Mach 3 are examined. The cross section of the intake model is presented and the test method is described. The performance of the supersonic intake is evaluated. Y.P.Q.

A92-43205

WIND TUNNEL TEST OF A SUPERSONIC AIR INTAKE

HIDEKI NOMOTO and M. KUZUHARA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 484-487. In Japanese. refs

A Mach 3.5 mixed compression air intake model is introduced. The characteristics of the supersonic air intake are discussed.

The wind tunnel test is described, and the results of static pressure distribution measurement are analyzed. Y.P.Q.

A92-43226

AERODYNAMIC CHARACTERISTICS OF A HYPERSONIC AIRCRAFT

Y. OHAMA and K. WAKANA (Tohoku University, Sendai, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 568-571. In Japanese. refs

Wind tunnel testing and visualization of vortical flow over a delta wing is reported. The test results are given and flow visualization of a leading edge vortex is analyzed. The velocity distribution and spectral energy level distribution are presented. Y.P.Q.

A92-43227

STUDY OF THE FLOW FIELD AND MOLECULAR RADIATION HEATING AROUND A REENTRY VEHICLE

S. CHANG, T. MURAYAMA, and T. FUJIWARA (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 572-575. In Japanese. refs

A nonequilibrium air model for the AOTV (aeroassisted orbital transfer vehicle) is presented. Chemical reactions around the vehicle behind the shock wave are examined. The freestream properties and normalized distance along the stagnation streamline are evaluated. Y.P.Q.

A92-43228

LOW-SPEED WIND TUNNEL TESTING OF THE LATERAL CONTROL FORCE FOR THE UPPER RUDDER SURFACE OF A JOINED-WING AIRFOIL

TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA, and NAOTO TAKIZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 576-579. In Japanese. refs

A low-speed wind tunnel test of the lateral control force is reported. The configurations of the upper surface model are considered, and the control effectiveness of the upper surface is analyzed. Y.P.Q.

A92-43229

LOW-SPEED WIND TUNNEL TESTING OF A JOINED-WING AIRFOIL

TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA, and NAOTO TAKIZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 580-583. In Japanese. refs

A low-speed wind tunnel test for direct lateral control force of an aircraft is reported. The configurations of the joined-wing airfoil model are described, and both longitudinal and lateral aerodynamic characteristics are discussed. Oil flow photographs of the airfoil are presented. Y.P.Q.

A92-43230

EFFECTIVENESS OF AIRCRAFT AERODYNAMIC PERFORMANCE ON EACH PART OF A JOINED WING

TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA, and NAOTO TAKIZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 584-587. In Japanese. refs

The configurations of a joined wing model are presented. The lateral force coefficients of the horizontal tail span are examined. The characteristics of the joined wing airfoil are described, and oil flow visualization results are reported. Y.P.Q.

A92-43231

AERODYNAMIC CHARACTERISTICS OF A HIGH-SPEED COMPOSITE AIRFOIL

Y. KOSHIOKA and HIDEO ISO (Fuji Heavy Industries, Ltd., Tokyo,

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Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 588-591. In Japanese. refs

The aerodynamic characteristics of a supersonic composite airfoil are examined. The aerodynamic shape design of a high-speed composite airfoil is described. A wind tunnel test of aerodynamic characteristics and the performance of a delta wing are reported. Y.P.Q.

A92-44519

NUMERICAL INVESTIGATION OF SUPERSONIC INLET WITH REALISTIC BLEED AND BYPASS SYSTEMS

AKIRA FUJIMOTO (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), NOBUO NIWA (Kawasaki Heavy Industries, Ltd., Seishin, Japan), and KEISUKE SAWADA (Tohoku University, Sendai, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 857-861. Research sponsored by Society of Japanese Aerospace Companies and Kawasaki Heavy Industries, Ltd. Previously cited in issue 06, p. 794, Accession no. A91-19150. refs

Copyright

A92-45385

SPACEPLANE LONGITUDINAL AERODYNAMIC PARAMETER ESTIMATION BY CABLE-MOUNT DYNAMIC WIND-TUNNEL TEST

SHUICHI SASA, MINORU TAKIZAWA, TAKASHI SHIMOMURA, and OSAMU NONAKA (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 141-149. refs

(SAE PAPER 911980) Copyright

Cable-mount dynamic wind-tunnel tests were conducted in a low-speed wind tunnel for the purpose of extracting aerodynamic parameters of a 5 percent spaceplane model. The cable-mount dynamic wind-tunnel experiment is described. An identification technique composed of flight path reconstruction and regression analysis and the maximum likelihood method for the identification of the parameters in the linear dynamic system were applied to the wind-tunnel test data. The estimation results for the aerodynamic parameters obtained by the two methods are compared. Author

A92-45386

EXPERIMENTAL STUDIES ON AERODYNAMIC CHARACTERISTICS OF SSTD VEHICLE AT LOW SUBSONIC SPEEDS

YOSHITO MIYAMOTO, TOSHIMI FUJITA, AKIHITO IWASAKI, and HIROTOSHI FUJIEDA (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 151-158.

(SAE PAPER 911981) Copyright

For a fully reusable space transportation system of an SSTD of the horizontal takeoff and landing type, experimental studies on low-speed aerodynamic characteristics have been done. Wind tunnel tests were conducted using NAL's gust wind tunnel. Six-component force and moment data were obtained over an angle of attack range from -14 to 44 deg. In this paper, aerodynamic test results are presented for the low-speed aerodynamics of a generic SSTD configuration. Author

A92-45393

NUMERICAL SIMULATIONS OF SEPARATED FLOWS AROUND OSCILLATING AIRFOIL FOR DYNAMIC STALL PHENOMENA

SHIGERU ASO, ATSUSHIRO SAKAMOTO (Kyushu University, Fukuoka, Japan), and MASANORI HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu,

Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 241-248. refs

(SAE PAPER 911991) Copyright

A92-45395

WIND TUNNEL INVESTIGATION OF AN IMPROVED UPPER SURFACE BLOWN FLAP TRANSPORT SEMI-SPAN MODEL

HITOSHI TAKAHASHI, MASAHIRO OKUYAMA, HIROTOSHI FUJIEDA, TOSHIMI FUJITA, and AKIHITO IWASAKI (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 259-267. refs

(SAE PAPER 911993) Copyright

This paper describes the investigations which have been conducted to improve the aerodynamic characteristics of a subsonic jet transport semi-span model with an Upper Surface Blowing Flap system which has been newly designed using the NAL STOL CAD program. The tests were conducted in the NAL 2 by 2 meter Gust Wind Tunnel and results were obtained for several flap and slat deflections at engine thrust coefficients from 0 to 1.85

Author

A92-45401

RESPONSE CHARACTERISTICS OF A WING IN SUPERSONIC FLOW NEAR FLUTTER BOUNDARY

HIROSHI TORII (Meijo University, Nagoya, Japan) and YUJI MATSUZAKI (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 309-314. refs

(SAE PAPER 911999) Copyright

The subcritical flutter characteristics of wings in a supersonic flow are examined. Especially the scattering property of the criterion parameters which are used in order to estimate a flutter boundary, is studied. The wing response due to the flow turbulence is expressed by the autoregressive moving-average process through Akaike's estimation procedure. The wing stability is evaluated by applying the Jury's stability determinant method for a discrete system to the estimated time series model. The flutter boundary is predicted by plotting the Jury's stability criterion parameter at several dynamic pressures in the subcritical range. As the dynamic pressure approaches to the flutter boundary, the estimated stability parameter and its scattering monotonically decreases while the damping, the conventional flutter estimation criterion, scattered so much near the flutter boundary. Author

A92-45404

RECENT APPLICATIONS OF THE FNS ZONAL METHOD TO COMPLEX FLOW PROBLEMS

KOZO FUJII and YOSHIKI TAMURA (Institute of Space and Astronautical Science, Sagami, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 341-350. refs

(SAE PAPER 912003) Copyright

A newly developed zonal technique utilizing the interface scheme based on the Fortified Navier-Stokes concept is applied to steady and unsteady flow problems. Two computational results are given as application cases to unsteady flow problems. The results show that this technique alleviates the difficulty of the simulation of complex flow configuration. It is shown that several types of zonal approach including overlaid, overlapped, and multiblock methods are treated in the same manner under this concept, and that the present zonal method can make a conventional program be an effective CFD tool for the analysis of complex flow configuration. R.E.P.

A92-45405

FREE WAKE ANALYSES OF A HOVERING ROTOR USING PANEL METHOD

GIZO HASEGAWA, HIROYUKI NAKAGAWA, TAKASHI SATO, and TOMOARI NAGASHIMA (National Defense Academy, Yokosuka,

Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 351-364. refs
(SAE PAPER 912004) Copyright

Employing a higher order vortex panel technique, 3D wake analyses are conducted for a rotor in hover. New methods are proposed to incorporate wake deformations due to wake-ground interactions into performance predictions. Numerical results of wake geometries for rotors at close proximity and isolated to inclined ground surface are presented and advantages of the proposed method are discussed. R.E.P.

A92-45409

FLOW FIELD AROUND THICK DELTA WING WITH ROUNDED LEADING EDGE

YOSHIJI NAKAJIMA, YOSHIYUKI NAKAO, YOSHIKI NAKAMURA, and MICHIRU YASUHARA (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 393-404. refs
(SAE PAPER 912009) Copyright

A thick delta wing with a rounded leading edge has been experimentally studied. To understand the basic flowfield of such a wing, experiments have been conducted in the low-speed wind tunnel at Nagoya University. Three types of flow visualization: oil flow, smoke wire, and tuft methods are employed, and forces: lift and drag, and pressure distributions were also obtained. The same test has been conducted for a thin delta wing for comparison. The results show the different flowfield of the thick delta wing from those commonly known for delta wings. However, in other properties except for the flow pattern, similarities were observed between the thick delta wing and thin delta wing. Author

A92-45412

NUMERICAL SIMULATION OF A SUPERSONIC JET IMPINGEMENT ON A GROUND

NOBUYUKI TSUBOI, A. K. HAYASHI, TOSHI FUJIWARA (Nagoya University, Japan), KAZUO ARASHI (Churyo Engineering Co., Ltd., Aerodynamics Research Dept., Nagoya, Japan), and MASARU KODAMA (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 421-433. refs
(SAE PAPER 912014) Copyright

The impingement on the ground of underexpanded uniform and nonuniform axisymmetric supersonic jets at atmospheric conditions is simulated numerically using 2D and cylindrically symmetric Euler equations for a perpendicular ground and 3D Euler equations for ground inclined from 0 to 45 deg. The numerical results are compared with those of an experimental study of underexpanded axisymmetric supersonic N2 jets impinging on a ground which inclines from 0 to 45 deg. The results of experiments showed that the maximum pressure on the inclined ground is larger than that on the perpendicular ground due to the possibility of high pressure recoveries through multiple shock systems. I.S.

A92-45413

AERODYNAMIC CHARACTERISTICS NEAR THE TIP OF A FINITE WING BY A PANEL METHOD

JANGSOO CHOI and YOSHIYUKI SUGIYAMA (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 435-443. refs
(SAE PAPER 912020) Copyright

The aerodynamic characteristics around a wing tip are investigated with a first order panel method. The geometry chosen for the study is a rectangular wing of aspect ratio 8.43, with RAF6 airfoil of 10 percent thickness ratio. The panel method gives similar aerodynamic characteristics to experimental ones even near the

tip, such as a dominant suction pressure distribution present near the trailing edge around the tip, and the increase in the local lift and drag at the very narrow region of the tip. These properties are caused by the strong spanwise velocity component around the wing tip, the inviscid effects of which are described in detail, with respect to pressure coefficient, local lift and drag coefficients, downwash, and vorticity on the wing. Author

A92-45414

AERO-STRUCTURAL INTEGRATED DESIGN OF FORWARD SWEEP WING

JUNICHI MIYAKAWA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), TAKESHI OHNOKI, and NOBUHIKO KAMIYA (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 445-450. refs
(SAE PAPER 912021) Copyright

Forward swept wing (FSW) is known to have excellent performance relative to aft swept wing. The practical application, however, has been limited due to its structural divergence characteristics. The current progress in materials, especially anisotropic composites has opened up a new future for FSW. This paper describes a design study of FSW for transonic transport looking for high drag divergence performance. Inverse code is applied to FSW aerodynamic design to achieve an isobar design concept. The performance is verified by transonic wind tunnel test. The paper also mentions the development of aero-structural integrated design tool, a combination of aerodynamic analysis code and structural analysis code, which is essential to FSW wing development. Author

A92-45417

EXPERIMENTAL AND NUMERICAL STUDIES OF RADIATION EMISSION FROM HIGH-TEMPERATURE AIR BEHIND 10 KM/S SHOCK WAVES

HIROKI HONMA (Chiba University, Japan) and HIROYUKI IIZUKA (Mitsubishi Atomic Power Industries, Inc., Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 471-482. refs
(Contract MOESC-61420021; MOESC-63302022; MOESC-02252105; MOESC-03238105)
(SAE PAPER 912025) Copyright

In order to estimate the exact heat transfer from shock-heated air to the reentering space vehicles, accurate understanding of its radiative characteristics is needed. The 10 km/s shock waves are produced by a free-piston, double-diaphragm shock tube, and the total and spectral-resolved radiation intensities of the shocked air are observed by using an image converter camera and a pair of photomultipliers. The numerical analysis is carried out for 1D steady hypersonic flows with nonequilibrium chemical reactions of hot air, including the evaluation of radiation intensity. The double-peak characteristic of radiation intensity for the shock waves above 10 km/s and the time-lag of radiation peak for different wave length are experimentally observed and qualitatively reproduced in numerical simulation. Author

A92-45418

MULTIDIMENSIONAL EULER/NAVIER-STOKES ANALYSIS FOR HYPERSONIC EQUILIBRIUM GAS

TAKUJI KISHIMOTO (Kawasaki Heavy Industries, Ltd., Gifu Technical Institute, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 483-490. Research supported by NASDA. refs
(SAE PAPER 912026) Copyright

Numerical simulations of hypersonic flow around a 2D cylinder and a 3D complete reentry vehicle have been carried out by solving Euler/Navier-Stokes equations which incorporate the equation of state for an equilibrium gas. The governing equations are solved

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by an implicit finite volume total variation diminishing upwind scheme using a two-equation turbulence model for a viscous flow. Curve-fits for the thermodynamic and transport properties of an equilibrium air are adopted in order to estimate real gas effects. Convective fluxes are calculated by the Roe's approximate Riemann solver generalized for an equilibrium gas. The results of hypersonic flow analysis using this code suggest that the real gas effects, such as chemical reaction, are not negligible to predict the hypersonic flow characteristics accurately. Author

A92-45419

A CALCULATION OF PENETRATION OF THE JET ISSUING NORMALLY INTO A CROSS FLOW ACROSS A WALL BOUNDARY LAYER

YOSHIYUKI SUGIYAMA (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 491-500. refs (SAE PAPER 912029) Copyright

An increase in jet penetration due to the wall boundary layer is determined in the flow field, including an aerodynamic interference between the wall boundary layer and the jet. The aerodynamic effect of the wall boundary layer is replaced by that of a secondary vortex filament resulting from vorticity in the wall boundary layer. A differential equation governing the increase in jet penetration is derived using the circulation around the secondary vortex filaments, its induced velocity, and the empirical decay law of the jet axial velocity along the jet centerline. A numerical example of the present analysis shows good agreement with the experiment. This indicates that the vortex flow model used simulates the real flow conditions. Author

A92-45427

SHOCK INTERACTION INDUCED BY TWO HEMISPHERE-CYLINDERS

TETSUYA NAGASHIMA, YOSHIKI NAKAMURA, MICHIRU YASUHARA, and KIYOSHI TSUBOI (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 581-589. refs (SAE PAPER 912043) Copyright

A type IV interaction caused by a shock generated by a large hemisphere cylinder impinging on a blunt body was measured. The stagnation pressure coefficient increased by more than 5.0, or 2.8 times larger than without the interaction. The pressure decrease on the side opposite the shock was more rapid than on the impinging side. The detailed pattern of the interaction was studied using 2D numerical simulations. The results showed that the supersonic jet impinges on the subsonic region and that compression and expansion waves formed. The pressure and heat transfer distribution along the body surface were eight and four times as large, respectively, as those without the interaction. C.D.

A92-45428

AERODYNAMIC HEATING IN THREE-DIMENSIONAL SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTION INDUCED BY SWEEPBACK SHARP FINS IN HYPERSONIC FLOWS

SHIGERU ASO, SHOUZO MAEKAWA (Kyushu University, Fukuoka, Japan), and MASANORI HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 591-598. refs (SAE PAPER 912044) Copyright

For the fundamental study of aerodynamic heating of winged vehicle and space planes in hypersonic flow, the detailed structure of 3D shock wave/turbulent boundary layer interaction region induced by swept-back sharp fins is investigated by oil flow technique and pressure distribution. The major objectives were to

study the effects of the shape of the leading edge of the fin to the flow fields on the body and to study the effects of the sweep angle of the leading edge of the fin to the interaction region. Also, aerodynamic heating phenomena in the flow fields are investigated by using a new technique. For the measurements, a new method of measuring heat flux is used. The new method is based on a new type of thin-film heat transfer gauge with high spatial resolution and fast response. The results suggest the effects of the shape of the leading edge to the flow fields are quite significant and the sweep of the leading edge of the fin to freestream is quite important to reduce the interaction region. Author

A92-45429

NUMERICAL SIMULATIONS OF HYPERSONIC REAL-GAS FLOWS OVER SPACE VEHICLES

MASAHITO NAKAO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) and KOZO FUJII (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 599-606. refs (SAE PAPER 912045) Copyright

Hypersonic flows over simple 3D bodies and a space vehicle are simulated using a real-gas Navier-Stokes code under an equilibrium air assumption. This code is based on 3D upwind flux splitting scheme with generalized Roe's Riemann solver. The real-gas effect is incorporated using the VEG (Variable Equivalent Gamma) method. The equivalent gamma and other thermodynamic properties are calculated using empirical curve fits. Author

A92-45443

OSCILLATION OF OBLIQUE SHOCK WAVES GENERATED IN A TWO DIMENSIONAL ASYMMETRIC NOZZLE

FUMIO HIGASHINO, SHIGERU MATSUO (Tokyo Noko University, Koganei, Japan), and TARO TSUYUKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 749-757. Research supported by MOESC. refs (SAE PAPER 912061) Copyright

The development and the oscillation phenomena of pseudoshock waves in a 2D asymmetric nozzle are investigated experimentally. A shock tube was used to generate supersonic flows in nozzles which consisted of both short and long walls diverging in the flow direction. The oscillation frequencies were determined from pressure measurements by means of a piezo-pressure transducer fixed at different loci. It was found that an oblique shock wave appeared near the turning corner of the diverging section owing to a separation vortex, and then it developed into a pseudoshock wave. The supersonic flow that issued from the duct was not significantly expanded in the flow direction and behaved like an underexpanded jet which was deflected toward the shorter wall of the nozzle. The oscillation frequency was not affected by the initial pressure. When the initial pressure decreased, the oscillation amplitude increased. C.A.B.

A92-45445

NUMERICAL ANALYSIS OF RCS JET IN HYPERSONIC FLIGHTS

YUMIKO INOUE, A. K. HAYASHI, TOSHI FUJIWARA (Nagoya University, Japan), SHO MIYAKE, and TADASHI KATSURAHARA (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 767-774. refs (SAE PAPER 912063) Copyright

A transversely injected jet into a hypersonic flow is simulated numerically in order to study the flow field of the injection jet in the hypersonic atmosphere, its heat flux on the body surface, and the moments working on the body. The flow field is governed by

the 2D Reynolds-averaged full Navier-Stokes equations with an algebraic eddy viscosity model developed by Baldwin-Lomax. The governing equations are solved using the Harten-Yee type TVD and central difference schemes for the convex and viscous terms, respectively. The real gas effect is considered in the numerical analysis. The jets injected across the main flow of Mach 10 and 15 are compared. Author

A92-46791* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

PREDICTED PRESSURE DISTRIBUTION ON A PROP-FAN BLADE THROUGH EULER ANALYSIS

MAKOTO KOBAYAKAWA (Kyoto University, Japan), RYOJI TAKAKI (National Aerospace Laboratory, Chofu, Japan), YOSHIFUMI KAWAKAMI (Sumitomo Precision Products, Ltd., Amagasaki, Japan), and FREDERICK B. METZGER (Hamilton Standard, Windsor Locks, CT) (ICAS, Congress, 17th, Stockholm, Sweden, Sept. 9-14, 1990, Proceedings. Vol. 2, p. 2073-2081) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 4, July-Aug. 1992, p. 627-631. Research supported by NASA. Previously cited in issue 09, p. 1311, Accession no. A91-24514. refs Copyright

**A92-46814
WING DESIGN FOR HANGGLIDERS HAVING MINIMUM INDUCED DRAG**

TAKESHI SUGIMOTO (Tokyo, University, Japan) Journal of Aircraft (ISSN 0021-8669), vol. 29, no. 4, July-Aug. 1992, p. 730, 731. refs Copyright

The optimum wing design for hang gliders with minimum induced drag is analyzed in the context of lifting line theory. The analysis accounts for the bending moment at the wing root. Optimum solutions are presented. V.L.

**A92-47100
ANALYSIS OF MOTION OF AIRFOIL FLYING OVER WAVY-WALL SURFACE (LIFTING SURFACE METHOD)**

SHIGENORI ANDO (Tokushima Bunri University, Japan), TETSU SAKAI, and KYOKO NITTA (Nagoya University, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 35, no. 107, May 1992, p. 27-38. refs

A 2D motion of a thin airfoil flying over and in proximity to a wavy-wall surface in incompressible and inviscid flow is analyzed. The problem is reduced to a version of the lifting surface problem. It is found that about ten times the airfoil chord length may be satisfactory with sufficient margin. Results agree well with those obtained with the finite difference method. Examples of computation are presented for two problems: a forced vibration problem and seaworthiness for a wing-in-ground effect vehicle. O.G.

**A92-47153
A FINITE DIFFERENCE SOLUTION OF THE EULER EQUATIONS ON NON-BODY-FITTED CARTESIAN GRIDS**

KOJI MORINISHI (Kyoto Institute of Technology, Matsugasaki, Japan) (Japan - Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 3, July 1992, p. 331-344. refs

Copyright

A finite difference solution on non-body-fitted Cartesian grids has been developed for the two-dimensional compressible Euler equations. The solution is based on the method of lines. The spatial derivatives of the Euler equations are first discretized by finite difference approximations on stretched grids. The rational Runge-Kutta scheme is used as the time-stepping scheme. Accurate numerical boundary conditions are introduced at the body surfaces where the coordinate lines do not generally fit the boundaries. A series of numerical experiments are carried out to validate the present solution. Numerical results obtained for transonic flows over single-element airfoils agree well with reliable results obtained for the same flows on body-fitted grids. Typical

numerical results are also obtained for transonic flows over bi-NACA0012 airfoils. The present solution is confirmed to be easily tractable even for multielement flowfields. Author

**A92-47155
NUMERICAL EXPERIMENTS ON UNSTEADY SHOCK REFLECTION PROCESSES USING THE THIN-LAYER NAVIER-STOKES EQUATIONS**

SHIGERU ASO (Kyushu University, Fukuoka, Japan) and MASANORI HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) (Japan - Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 3, July 1992, p. 369-375. refs Copyright

Processes of shock reflection by a ramp are simulated by solving the thin-layer Navier-Stokes equations using the TVD scheme in the convective terms. Calculations were performed to study viscous effects in unsteady aerodynamic heating and weak Mach reflections. Unsteady aerodynamic heating due to the impingement and the Mach stem and slip layer in shock reflection at higher M_s values were calculated numerically. In addition, Mach reflections at lower M_s are calculated numerically to investigate the viscous effects on weak shock reflection by a ramp. Significant changes in the reflection patterns with Re were observed. L.M.

**A92-48704#
A HIGHER-ORDER ACCURATE NAVIER-STOKES SOLVER FOR TRANSONIC AND SUPERSONIC FLOWS IN TURBOMACHINERY**

SATORU YAMAMOTO and HISAAKI DAIGUJI (Tohoku University, Sendai, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 9 p. refs

(Contract MOESC-03238202; MOESC-02452114; MOESC-03750110)

(AIAA PAPER 92-3044) Copyright

A higher-order Navier-Stokes solver is presented which is based on a compact MUSCL TVD finite-difference scheme with fourth-order accuracy in space and second-order accuracy in time. Shocks, weak discontinuities, and vortices can be captured through this scheme more accurately than through the existing TVD scheme. Numerical results indicate that the proposed solver has a capability of simulating the flow which has never been estimated yet by the existing solver for turbomachinery. The dramatic improvement of the resolution for shocks, vortices and their interactions is remarkable for the Navier-Stokes solver which will be developed in future to analyze complex flow in advanced turbomachinery. O.G.

**A92-48705#
APPLICATION OF NON-REFLECTING BOUNDARY CONDITIONS TO THREE-DIMENSIONAL EULER EQUATION CALCULATIONS FOR THICK STRUT CASCADES**

KUNIYUKI IMANARI and HIDEKAZU KODAMA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 10 p. refs (AIAA PAPER 92-3045) Copyright

In the present paper, three-dimensional non-reflecting boundary conditions regarding pressure waves and associated components in density and velocity waves have been formulated and applied to time-marching Euler equation calculations of steady flows around uncambered thick strut cascades. The linearized solutions including a Fourier-Bessel double expansion with an exponential variation in the axial direction have been developed for far-field perturbations from the uniform free stream with subsonic axial velocity in a cylindrical annular duct, and used to provide the information for the correction of boundary conditions. Numerical examples for the symmetric struts and the nonuniform strut cascades comprising two types of vanes have demonstrated the correctness and accuracy of the present method, allowing a considerable reduction of the computational domain. Author

02 AERODYNAMICS

A92-48804#

NUMERICAL INVESTIGATION OF SURGE AND ROTATING STALL IN MULTISTAGE AXIAL COMPRESSORS

H. ISHII and Y. KASHIWABARA (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Ibaraki, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 11 p. refs (AIAA PAPER 92-3193) Copyright

This paper investigates the effects of various parameters on the inception and post-stall characteristics of surge and rotating stall in multistage axial compressors by using a proposed numerical model. The parameters include the shape of the total pressure-loss and deviation angle characteristics, IGV outlet flow angle, inlet flow distortion, and bleeding. Some of the major findings are: there exist two types of rotating stall differing in magnitude; inlet distortion and the deterioration in compressor performance lower the inception margin of unstable behaviors; an optimal bleeding can exist to make the inception margin of unstable behaviors optimal. The usefulness of the present model is examined by the numerical investigations. The validity of the model is also discussed by comparisons with test results in a 3-stage compressor. Author

A92-48817#

NUMERICAL SOLUTIONS OF UNSTEADY OSCILLATING FLOWS PAST AN AIRFOIL

KOJI MORINISHI and SHIGERU MURATA (Kyoto Institute of Technology, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 11 p. refs (AIAA PAPER 92-3212) Copyright

The numerical solutions of the incompressible Navier-Stokes equations are used to investigate the unsteady oscillating flows past an airfoil. The time accurate solutions of the Navier-Stokes equations are obtained by the method of artificial compressibility. The rational Runge-Kutta scheme is used for subiterations in the pseudotime. The convergences in the subiterations are accelerated by a multigrid algorithm. Sinusoidally oscillating flows are superimposed on uniform free streams. The Reynolds number and angle of attack of the uniform flows are fixed at 1000 and 15 deg, respectively. The reduced amplitude of the superimposed flows ranges from 5 to 20 percent of the uniform flow velocities, while the reduced frequencies are close to harmonics of the free vortex shedding frequency. The time histories of the lift coefficients are analyzed by means of a spectral analysis. The time histories of the lift coefficients at the small amplitude of the forced flows, oscillate at the forced frequency combined with the free vortex shedding frequency. The time histories at the larger forced amplitude oscillate at the forced frequency. Author

A92-50327

INDUCED DRAG OF A WING IN A CIRCULAR WIND TUNNEL

YUZU YAMAMOTO (Gifu National College of Technology, Motosu, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, no. 9, Sept. 1992, p. 2344-2346. refs Copyright

The closed forms of both the minimum induced drag and the spanwise optimum lift distribution in the closed tunnel case are obtained. Open-tunnel case explicit expressions of both the minimum induced drag and the spanwise optimum lift distribution are obtained. R.E.P.

A92-51593

THREE-DIMENSIONAL RELAXATION EFFECT ON QUASI-3D FLOW IN A BLADE ROW WITH SPANWISE LOADING DISTRIBUTION

TAE W. KIM, MASATO FURUKAWA, MASAHIRO INOUE (Kyushu University, Fukuoka, Japan), KUZUTO SASAKI, and SUMIO YAMAGUCHI (Fukuoka University, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 52, no. 1, March 1992, p. 117-129. refs

This paper presents a quasi-3D flow calculation method including the 3D flow relaxation effect in turbomachinery. A meridional flow solution is obtained by a streamline curvature

method with an equilibrium equation formulated by exactly averaging the equation of continuity, momentum, and energy equation in the circumferential direction. To verify the validity of the method, it is applied to the flow analysis of a diagonal flow fan designed under a vortex type of constant circumferential velocity. The comparison of the calculated results with the experimental data shows a good agreement except in the region where the flow field is affected by the tip leakage flow. Author

A92-52726

FLOW OF A RAREFIED GAS PAST A TWO-DIMENSIONAL BODY OF AN ARBITRARY SHAPE AT SMALL MACH NUMBERS

KYOJI YAMAMOTO and TAKUJI SANRYO (Okayama University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 255-262. refs Copyright

This paper is concerned with a method of analysis of a rarefied gas flow past a two-dimensional body of an arbitrary shape when the rarefaction is not too high and when the Mach number is small. The main flow around the body is treated by the Oseen-Stokes equation, while the flow in the kinetic region adjacent to the body surface whose thickness is of the order of the mean free path is analyzed by the linearized BGK equation. Both solutions are matched at the outer edge of the kinetic region. As an example of the present analysis, the flows past a circular and an elliptic cylinder are considered. Author

A92-52749

THERMAL AND CHEMICAL NONEQUILIBRIUM VISCOUS SHOCK LAYER FLOWS OVER A BLUNT BODY AT HIGH ALTITUDES

MICHIO NISHIDA and YOSHITAKA SAKAMURA (Kyushu University, Fukuoka, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 514-521. refs Copyright

Numerical studies of hypersonic flows with thermal and chemical nonequilibrium around a blunt body have been conducted related to reentry at high altitudes. A two-temperature model of translational-rotational and vibrational temperatures was employed and nonequilibrium air chemistry was considered. The analysis was performed using axisymmetric viscous shock layer equations for multicomponent gas mixture. The effect of the profile of vibrational temperature on the flowfield was investigated for four different wall conditions for vibrations temperature. The result indicates that the translational temperature profile is not significantly dependent on such wall condition. The vibrational temperature profiles for four wall conditions are almost the same except for in the vicinity of the wall. The wall temperature obtained from the radiative equilibrium condition is much influenced by surface catalysis rather than the wall condition for the vibrational temperature. Author

A92-52766

DIRECT SIMULATION OF VORTEX SHEDDING IN DILUTE GAS FLOWS PAST BLUFF BODIES

KATSUHISA KOURA (National Aerospace Laboratory, Chofu, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 695-702. refs Copyright

The vortex shedding in dilute gas flows past the bluff bodies of a normal flat plate and a circular cylinder is studied using the null-collision direct-simulation Monte Carlo method for the $M(\infty) = 0.7$ and $Kn(\infty) = 1/60$ and $1/200$, for which the Reynolds number, $Re(\infty) = 69.2$ and 231 , respectively. When a bluff body is instantaneously inserted in the free stream without any artificial velocity perturbation, a symmetric flow pattern with a pair

of contrarotating vortices is obtained and no vortex shedding occurs. Introducing a temporary (sufficiently large) perturbation into the flow velocity generates the vortex shedding for $Re(\infty) = 231$ but no vortex shedding for $Re(\infty) = 69.2$. The Strouhal number evaluated from the vortex generation at $Re(\infty) = 231$ is about 0.25 and 0.2 for a normal flat plate and a circular cylinder, respectively. Author

A92-52772

DSMC SIMULATION OF HYPERSONIC FLOWS PAST 2-DIMENSIONAL BODIES

MICHRU YASUHARA, YOSHIKI NAKAMURA, and JUNICHI TANAKA (Nagoya University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 755-762. refs

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Two-dimensional flows about three body shapes (a flat plate with sharp leading edge, a cylinder, and a blunt wedge) are simulated using the direct simulation Monte Carlo (DSMC) method, and several aerodynamic coefficients, including C_f , C_p , and the Reynolds analogy factor $Cf/2C(II)$ are calculated on the body surfaces. The investigation of the effect of accommodating the rotational energy at the wall on the flow in the case of flat plate showed that, while the C_f is not affected by the rotational energy accommodation, the C_p depends on it. Along a cold wall, the value of $Cf/2C(II)$ became constant, while at a hot wall the value of $Cf/2C(II)$ increased with the distance from the leading edge. Calculation of the drag coefficient for the cylinder showed that the drag coefficient is almost independent on the mass temperature but increases with the Knudsen number. I.S.

A92-52778

DIRECT SIMULATION OF HYPERSONIC RAREFIED FLOWS ABOUT ATMOSPHERIC RE-ENTRY CAPSULES

TORU SHIMADA (Nissan Motor Co., Ltd., Tokyo, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 800-807. refs

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Hypersonic flows in the transition regime around a blunt-cone and a Gemini-type capsules are investigated by the direct simulation Monte Carlo method combined with general body-fitted grid systems generated along with the multiblock concept. The null-collision technique is employed for collision sampling. Real air model includes the VHS molecular model, Borgnakke-Larsen's concept of handling molecular internal degree of freedom, and the steric factor of Bird for chemical reactions. Obtained flowfield structure shows variations of the rarefaction effect and chemical activities with flight altitudes and body shapes. Surface pressure distribution is in fair agreement with theoretical references, but not good enough. Heat transfer coefficients are compared with a bridging formula and good agreement is found for the Gemini-type cases, while disagreement is seen for the blunt-cone cases. The present program is quite versatile for various geometries, but more efficiency is desired. Author

A92-53009

MEASUREMENT OF ANGLE OF ATTACK USING A FIVE-HOLE ARROW HEAD PITOT TUBE

HIROBUMI OHTA and NAOYA WAKAMATSU Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 463, 1992, p. 464-466. In Japanese.

A five-hole arrow head pitot tube is tested to measure flight velocity and angle of attack. This paper presents experimental equations with corrective coefficients. These equations make it possible to calculate flight velocity and angle of attack in terms of the measured pressure. The time lag corresponding to the change of angle of attack is also reported. Author

A92-53547

AERODYNAMIC HEATING CHARACTERISTICS OF SPACE PLANES TESTED BY NAL HYPERSONIC WIND TUNNEL

YASUTOSHI INOUE, TADAO KOYAMA, AKIRA YOSHIZAWA, and KOUICHI HOZUMI (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 707-712. refs

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Heat transfer rate distributions of space plane models have been experimentally investigated in Mach 7.1 hypersonic air flow with parametrically modified geometries. The characteristics of the distribution pattern and the peak heating values at the nose and at the leading edge are examined. The results show the predominant wing sweep angle effect on the leading edge peak heating and the outstanding differences in the distributions of the leeward surfaces based on flow separation and reattachment. C.D.

A92-53548

HYPERSONIC NONEQUILIBRIUM FLOW COMPUTATION AROUND SPACE VEHICLES

YASUHIRO WADA, SATORU OGAWA (National Aerospace Laboratory, Chofu, Japan), HIROTOSHI KUBOTA (Tokyo, University, Japan), and TOSHIO AKIMOTO (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 719-728. refs

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Chemically reacting flows around 3D space vehicles are computed by the higher-order upwind scheme based on a generalized Roe's approximate Riemann solver. A fully implicit time integration method is used to accelerate convergence rates. Several hypersonic reacting flows are computed. The shock stand-off distance over a hemisphere cylinder agrees very well with experimental data, while a perfect gas computation overestimates it. The aerodynamic characteristics of the Space Shuttle are compared with the STS-2 flight data and good agreement is obtained, indicating the forward shift of the center of pressure by real gas effects. The hypersonic flow around the HOPE and a space plane is presented as well. Author

A92-53549

HYPERSONIC FLOWS WITH AIR CHEMISTRY OVER A REENTRY VEHICLE AT HIGH ALTITUDES

YOSHITAKA SAKAMURA (Kyushu University, Fukuoka, Japan), HITOSHI KAWABATA (Ishikawajima-Harima Heavy Industries, Co., Ltd., Engine Design Dept., Tanashi, Japan), and MICHIO NISHIDA (Kyushu University, Fukuoka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 729-734. refs

Copyright

The governing equations for viscous shock layer flow with thermal and chemical nonequilibrium are numerically solved for the flight regimes of NASDA's reusable low-cost space transportation system HOPE. The equations are formulated for a multicomponent gas flow the thermal and chemical nonequilibrium. The results show that the temperature profile on the stagnation streamline is strongly affected by dissociation of air. The vibrational temperature tends to equilibrate with the translational-rotational temperature at lower altitudes. C.D.

A92-53552

RAREFIED GAS NUMERICAL WIND TUNNEL

KATSUHIKA KOURA (National Aerospace Laboratory, Chofu, Japan), EMI KANEMATSU, and YUKIKO KIMURA (Fujitsu, Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 747-752. refs

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The 'rarefied gas numerical wind tunnel' (RGNWT) is constructed on the National Aerospace Laboratory Numerical

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Simulator System for the simulation of rarefied gas flows around 2D or 3D flight bodies. The RGNWT consists of the simulation program universally described using the null-collision direct-simulation Monte Carlo method, which is very effective for 3D simulations, and the pre- and post-process programs for the collision-cell generation, the graphic display, etc. The computation domain is taken as a rectangular solid and divided into small rectangular-solid collision cells for the simulation of molecular collisions. The aerodynamic characteristics and flowfield properties of a whole flight body are calculated and illustrated. Some results obtained using the RGNWT without real gas effects are presented for a 2D flat plate and circular cylinder and a 3D delta wing.

Author

A92-53555

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF A SUPERSONIC FREE JET IMPINGING ON A PERPENDICULAR SURFACE

KOJI TESHIMA (Kyoto University of Education, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 765-770. refs
Copyright

An experimental apparatus was developed for observation of the transport phenomena in liquid together with the interface phenomena during unidirectional solidification processes of transparent material. An incoherent moire interferometric technique, which eliminated wavefront deformation by the interference of two interferograms at different times, made it possible to visualize the temperature profile in liquid. A time-dependent temperature profile in liquid was taken, and the growth rate of the solid-liquid interface was measured. It was found that when supercooled liquid was solidified quickly, the temperature reversed layer appeared due to the released latent heat, which was conducted not only to the solid but also to the liquid. The effect of thermal convection in an unstable system was also observed.

Author

A92-53556

NUMERICAL STUDY ON THE SECONDARY JET INTO A SUPERSONIC FLOW

MASAHIRO TAKAHASHI and OICHI HAYASHI (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 771-776. refs
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A 2D sonic hydrogen jet transversely injected into a supersonic hot air flow is simulated numerically to understand the phenomena and mechanism of the mixing and combustion processes. The flowfield is governed by the 2D Reynolds-averaged full Navier-Stokes equations with an algebraic eddy viscosity model developed by Baldwin and Lomax. Chemical kinetics are described by 9 species and 19 elementary reactions of the full hydrogen-oxygen system assuming nitrogen is inert. The numerical results are compared with the 2D experiment to study a validity of the turbulence model and the chemical kinetics model. The influence of the oxygen concentration in the main flow is studied.

Author

A92-53557

EXPERIMENTAL INVESTIGATION ON TURBULENT PHENOMENA IN THREE-DIMENSIONAL SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION INDUCED BY BLUNT FIN

SHIGERU ASO, SHIGEHIRO NAKAO (Kyushu University, Fukuoka, Japan), SEISHI KURANAGA (Mitsubishi Heavy Industries Co., Ltd., Nagoya, Japan), and MASANORI HAYASHI (Nishinippon Institute of Technology, Fukuoka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 777-782. refs
Copyright

Turbulent properties in the shock wave/turbulent boundary layer interaction induced by blunt fins with semicylindrical leading edge

have been investigated. Flowfields are visualized by the Schlieren method and oil flow technique. Pressure fluctuations are measured in the whole interaction region in order to understand the phenomena and provide sufficient information for turbulent modeling. Distributions of standard deviations and higher moments of pressure fluctuations are also measured. Those properties show significant changes in the interaction region and quite interesting characteristics are observed. In the interaction region, intermittent phenomena due to the shock wave motion are observed. The results suggest that more sophisticated turbulent modeling is necessary to simulate the flowfield.

Author

A92-53558

NUMERICAL SIMULATIONS OF SHOCK REFLECTIONS BY A TVD SCHEME

SHIGERU ASO (Kyushu University, Fukuoka, Japan) and MASANORI TAKANO (Toyota Motor Co., Ltd., Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 783-788. refs
Copyright

Shock reflection processes at a ramp are simulated here by solving thin-layer approximated Navier-Stokes equations using a TVD scheme in convective terms. Viscous effects in unsteady aerodynamic heating and weak Mach reflections are calculatively studied, and unsteady aerodynamic heating due to impingements of Mach stem and slip layers in shock-wave reflection at higher Mach numbers are numerically investigated. The results show good agreement with experiments. Mach reflections in lower Mach number ranges are calculated numerically, and significant changes of shock reflection patterns with Reynolds number are observed. The results show that viscous effects are quite important in weak shock reflections.

C.D.

A92-53559

NAVIER-STOKES SIMULATION FOR THE WINGED SPACE VEHICLE 'HOPE' AT SUBSONIC, TRANSONIC, AND SUPERSONIC REGIMES

MASAKAZU TACHIBANA, SUSUMU TAKANASHI (National Aerospace Laboratory, Tokyo, Japan), and TOSHIO AKIMOTO (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 789-797. refs
Copyright

Numerical simulations of subsonic, transonic, and supersonic flows for a winged vehicle HOPE were carried out using the Navier-Stokes equations. Calculated force coefficients were in good agreement with experimental data except for axial force. Oil-flow patterns also agree well with each other except for the location of strong shock wave near the trailing edge of the wing.

C.D.

A92-53560

CALCULATIONS FOR AERODYNAMIC CHARACTERISTICS OF HOPE TYPE VEHICLE IN SUBSONIC AND HYPERSONIC FLOW

MITSUBORI YANAGIZAWA (Tokyo, University, Japan) and TOSHIO AKIMOTO (NASDA, Sakura, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 799-806. refs
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The aerodynamic characteristics of a HOPE type configuration are investigated using the panel method in the subsonic region and Newtonian impact theory in the hypersonic region. An analysis of the results obtained indicates that the panel method, considered for its effect on the leading-edge vortex, should be used for wings with a large sweptback angle. The calculation of attached flow is partially correct, but correct results are not obtained for the aerodynamic coefficient. The Newtonian theory is shown to give roughly correct aerodynamic characteristics.

V.L.

A92-53579

RADIATIVE HEAT TRANSFER FROM NONEQUILIBRIUM SHOCK LAYER TO A HYPERSONIC REENTRY BODY

XIN-YU CHANG, AKIHIRO SASOH, and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 921-926. refs

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The hypersonic reentry of a space shuttle or similar vehicle into the atmosphere is analyzed with respect to the radiative heat transfer of the high-temperature shock layer to the vehicle surface. An axisymmetric blunt body is considered to be travelling at Mach 25 at 70 km through seven chemical species, and the flowfield is studied with Navier-Stokes equations from the two-temperature model by Park (1985). The results are substituted into NASA's NEQAIR code to calculate the radiation field with high spectral resolution. The radiative heating at the stagnation point is 3.5 W/sq cm as opposed to a smaller value given by a one-temperature model which does not allow for nonequilibrium thermal phenomena. Radiative heating is shown to be a key component of the heat transfer which is strongly correlated with temperature and number density. C.C.S.

A92-53580

THERMALLY AND CHEMICALLY NONEQUILIBRIUM HYPERSONIC FLOW IN THREE-DIMENSIONAL GEOMETRY

TOSHI MURAYAMA and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 927-932. refs

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The reentry of an axisymmetric space vehicle is analyzed with a one-temperature model and a two-temperature model incorporating the effects of both chemical and thermal nonequilibrium. The model includes the translational temperatures of heavy particles and the vibrational temperatures of molecules, and two sets of reactions/species are investigated. The first set comprises six reactions and seven species vs fifteen reactions and eleven species in the second model, and reentry runs are conducted for Mach 15, 20, and 25. Attention is given to the difference between the one- and two-temperature models, chemical reactions at different flight speeds, and the use of the different numbers of reaction/species. The model with more species can be used to treat the flows at Mach numbers 20 and 25, and the two-temperature model is found to be effective with this larger list of reactions/species. C.C.S.

A92-53641

AERODYNAMIC STUDIES ON SPACE PLANE CONFIGURATION AT HYPERSONIC SPEED

KOICHI HOZUMI, SHIGEYA WATANABE, and SHIGEKI NOMURA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1365-1376. refs

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The present analytical and experimental investigation of means for improving the aerodynamic configuration of an SSTO spaceplane proceeded by estimating the aerodynamic characteristics of configurations created by through changes of parametric variables. Ascent simulations were also conducted to estimate fuel requirements; the configuration thus defined was then subjected to force and moment measurement tests at the NAL hypersonic wind tunnel. The SSTO configuration thus defined is found to be superior to the initial baseline, with substantially greater L/D and trim characteristics. O.C.

A92-53997

EXPERIMENTAL STUDY ON THREE-DIMENSIONAL SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTION INDUCED BY PROTUBERANCE

SHIGERU ASO, SYOZO MAEKAWA, SHIGEHIDE NAKAO, KAZUO

ARASHI, KENJI TOMIOKA, and HIROYUKI YAMAO Kyushu University, Technology Reports (ISSN 0023-2718), vol. 65, no. 3, June 1992, p. 253-260. In Japanese. refs

Three-dimensional shock wave/turbulent boundary layer interaction region induced by protuberance is experimentally investigated. The structure of the flowfield is studied with the oil-flow technique and surface-pressure measurements. A flat plate model is installed in a supersonic wind tunnel and a fully developed turbulent boundary layer is obtained on the plate. A conventional shape of protuberance is selected and set on the plate. Three models with similar form and different sizes are used in order to investigate the effect of the height of the model on the interaction region for the same incoming boundary layer. The oil flow pictures show the quite complicated separated flows in the interaction region. The extent of separated region is investigated carefully. The results show that the height of protuberance is the primary scale factor of the flowfields, although detailed pressure distributions change significantly due to the height of the protuberance. Author

A92-54092#

MACH 3 WIND TUNNEL TEST OF MIXED COMPRESSION SUPERSONIC INLET

AKIRA MURAKAMI, RYOJI YANAGI, SHIGEMI SHINDO, KIMIO SAKATA (National Aerospace Laboratory, Tokyo, Japan), SHINJI HONAMI (Tokyo, Science University, Japan), ATSUSHIGE TANAKA, and KAZUO SHIRAIISHI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 7 p. Research supported by Agency of Industrial Science and Technology and New Energy and Industrial Technology Development Organization. refs

(AIAA PAPER 92-3625) Copyright

Two supersonic inlet models, designed in a 2D mixed compression configuration with a multishock system, were tested in a Mach 4 supersonic wind tunnel at the National Aerospace Laboratory in Japan. The first model was a fixed geometry with an 8-shock system, and the second one was a variable geometry with a 5-shock system and isentropic compression surfaces. The design Mach number for both models was 3. Pressure measurements and flow visualization, applying Schlieren method, oil-flow and vapor screen techniques, were conducted in the tests. Pressure recovery performance, stability of the shock associated flows, and the basic feature of the internal flows were investigated. Importance of establishing the shock systems and eliminating the shock-induced boundary layer separations were notified for the aerodynamic performance of the model from the test results. A consideration for the passage design of subsonic diffusers was also discussed. Author

A92-54498

THREE-DIMENSIONAL CALCULATION OF RADIATIVE FIELD IN HYPERSONIC AIR SHOCK LAYERS

AKIHIRO SASOH, XIN-YU CHANG, TOSHIYUKI MURAYAMA, and TOSHI FUJIWARA (Nagoya University, Japan) Nagoya University, Faculty of Engineering, Memoirs (ISSN 0027-7657), vol. 43, no. 2, 1991, p. 179-224. refs

The method of numerical calculation of three-dimensional radiative transfer from nonequilibrium air shock layers over a body is presented with some reviews on radiative transfer and molecular physics. A numerical technique, which reduces the necessitating memory size of a computational resource, thereby enabling one to conduct three-dimensional calculation, has been developed. This method is applied to radiative heat transfer problems under a reentry condition. The radiative structure of the hypersonic air shock layer generated around a body is closely related to the thermally nonequilibrium structure of the shock layer. A radiative heat transfer which is comparable with the convective one is calculated at such a high Mach number as 35 at an altitude 70 km. This result suggests the importance of radiative heat transfer in thermal design of a reentry vehicle. Author

02 AERODYNAMICS

A92-54936

EFFECT OF STREAMWISE PRESSURE GRADIENT ON THE SUPERSONIC MIXING LAYER

TAKASHI ABE, KATSUSHI FUNABIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan), HIRONOBU ARIGA (Musashi Institute of Technology, Tokyo, Japan), and KATSUMI HIRAOKA (Tokai University, Kanagawa, Japan) *AIAA Journal* (ISSN 0001-1452), vol. 30, no. 10, Oct. 1992, p. 2564-2566. refs

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The effect of the streamwise pressure gradient of the flow on the growth rate of the mixing layer formed at the interface of parallel supersonic flows is studied. The structure of the mixing layer is examined by in situ measurement of the concentration ratio of the gas mixture. It is found that, when a streamwise pressure gradient exists, the growth rate of the mixing layer is enhanced compared to the one without the gradient. The baroclinic torque produced by the streamwise pressure gradient may be the cause of the enhancement. C.D.

A92-56004

HIGH-SPEED AERODYNAMIC DESIGN OF SPACE VEHICLE AND REQUIRED HYPERSONIC WIND TUNNEL FACILITIES

S. NOMURA, K. HOZUMI, S. SAKAKIBARA, and K. SOGA (National Aerospace Laboratory, Chofu, Japan) *IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 16-19. In Japanese.*

Considerations and problems associated with the aerodynamic design of space vehicles at hypersonic speeds are presented, as well as the aerodynamic design logic and optimization techniques to develop and refine the configurations in a traditional phased approach based on the programmatic design of space vehicles. Current methodology for the determination of aerodynamic characteristics for designing space vehicles is also considered. In particular, the role of new NAL M10 hypersonic wind tunnel and the NAL gun tunnel and the interrelationship of the tunnels and CFD methods in an actual aerodynamic design and analysis is discussed. Author

A92-56006

SUPERSONIC WIND TUNNEL TEST OF AIRINTAKE/AIRFRAME INTEGRATED MODELS

T. ITO, A. MURAKAMI, J. NODA, S. SHINDO, K. SAKATA (National Aerospace Laboratory, Chofu, Japan), and A. TANAKA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) *IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 24-27. In Japanese.*

A series of Mach 3 tests of the first model for the intake-airframe integration problem was performed in NAL's M4 supersonic wind tunnel and the data was analyzed aerodynamically. The model of the air-intake with diverter is installed on the bottom surface of the airframe which was designed for Mach 3 flight. Schlieren method and oil-flow technique were applied for considering the flow structure around and on the model. Qualitative and some quantitative considerations on the effects of existence of the air-intake to the airframe aerodynamic coefficients are made clear and influence of the forebody boundary layer to the air-intake was also analyzed. Author

A92-56007

A HYPERSONIC WIND TUNNEL TEST OF A MIXED-COMPRESSION AIR INLET MODEL

HIDEKI NOMOTO and TADASHI KATSURAHARA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) *IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 28-31. In Japanese. refs*

A hypersonic wind tunnel test was performed for a mixed-compression type air inlet model. The model was a two-dimensional, mixed-compression type air inlet with a simulated forebody. Pressure recovery and pressure distributions on ramps

and duct walls were measured at free stress Mach number of 7.1. Effects of shock/boundary layer interaction were assessed quantitatively under various conditions of duct flow rate and boundary layer bleed. This hypersonic wind tunnel test of a mixed-compression air inlet proved the feasibility of an inlet of this type which can be operated at Mach numbers up to 7.1.

Author

A92-56008

WIND TUNNEL TEST OF M = 2.5 MIXED COMPRESSION INLET

AKIRA FUJIMOTO, TAKASHI UCHIDA, HAJIME ISAJI, KEN-ICHI TAKAHIRA, and NOBUO NIWA (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) *IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 32-35. In Japanese. refs*

Wind tunnel test of a two-dimensional mixed-compression inlet, designed for $M = 2.5$, was performed. Our CFD prediction about the mechanism of improving pressure recovery ahead of an inlet 'unstart' was confirmed by the schlieren observation. Comparison of the pressure distribution between the experiment and two-dimensional Navier-Stokes solution suggested strong three-dimensionality downstream of the terminal shock. The effect of a throat by-pass and vortex generators were also investigated. The total pressure recovery factor with and without vortex generators was found to be comparable. But distortion was remarkably improved when the vortex generators were attached on the subsonic diffuser. Author

A92-56009

THREE-DIMENSIONAL SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTION INDUCED BY BLUNT BODY AND PROTUBERANCE

SHIGERU ASO, SHOUZO MAEKAWA (Kyushu University, Japan), SHIGEHIDE NAKAO (Japan Air Lines Co., Ltd., Tokyo), KAZUO ARASHI, KENJI TOMIOKA (NASDA, Tokyo, Japan), and HIROYUKI YAMAO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) *IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 36-39. In Japanese. refs*

Three-dimensional shock wave/turbulent boundary layer interactions induced by blunt body and protuberance have been investigated carefully. The structures of the flowfields are studied in detail by oil flow technique and surface pressure measurements. For the interaction induced by blunt body the effects of the displacement between blunt body and flat plate to the interacting flowfields are investigated. The results suggest that the flowfield changes quite significantly due to displacement. For the interaction induced by protuberance the effects of the height of protuberance to the flowfields are investigated. The results show that the height of protuberance is the primary scale factor of the flowfields. However, detailed pressure profiles change due to the height of the protuberance. Author

A92-56010

ON THE STRUCTURE OF UNSTEADY SHOCK INDUCED SEPARATION OF THE TRANSONIC AIRFOIL IN THE NAL TWO-DIMENSIONAL WIND TUNNEL

HITOSHI MIWA, MAMORU SATO, HIROSHI KANDA, and SHIGEO BABA (National Aerospace Laboratory, Chofu, Japan) *IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 40-43. In Japanese. refs*

The structure of the shock wave system and the separating region on the airfoil in the test section of NAL two-dimensional wind tunnel was considered at the transonic buffeting condition. The wind tunnel test was carried out by means of measurements of pressure fluctuation on the surface of the airfoil and a position in the wake. At the same time, oil flow pattern observation on the surface of the airfoil and the side wall, observation of schlieren pictures of the oscillating shock wave system by using the high speed video camera and high speed optical camera were also performed. Author

A92-56040

THREE-DIMENSIONAL NUMERICAL ANALYSIS OF IMPINGING CIRCULAR JET - DISCRETE VORTEX METHOD

TERUHIKO KIDA (Osaka Prefecture, University, Sakai, Japan), TOSIYUKI MORIMOTO (Sumitomo Denko Co., Osaka, Japan), TOMOYA NAKAJIMA (Osaka Prefecture, University, Sakai, Japan), and ZENSABURO YASUTOMI (Kinki University, Osaka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 166-169. In Japanese. refs

The problem of a ring jet impinging to the ground is important for the aerodynamics of the ACV. This problem is simulated by using a discrete vortex method. The uniform ring jet at the nozzle exit is simulated by distributing ring sources. The distribution of vortex segments and the pressure distribution on the ground are shown for the transient cases. It is shown that the brim-length of the cushion chamber is very sensitive for the cushion pressure.

Author

A92-56041

DESIGN AND CALIBRATION OF AN RCS THRUSTER FOR AN ANAL SHOCK TUNNEL EXPERIMENT ON RCS-GASJET INTERACTION

HIROSHI WAKAI, TADASHI ISHIKAWA, KOUHEI TANAKA (Fuji Heavy Industries, Ltd., Aerospace Div., Utsunomiya, Japan), TAKASHI YANAZAKI, and KUNIO SOGA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 178-181. In Japanese. refs

A shock tunnel test of a reaction control system (RCS) is presented. The gasjet interaction test and calibration of RCS thruster test are addressed. The configuration of the RCS thruster is examined. Y.P.Q.

A92-56042

A SHOCK TUNNEL EXPERIMENT ON AERODYNAMIC INTERFERENCE INDUCED BY RCS JET

TAKASHI YANAZAKI, KUNIO SOGA (National Aerospace Laboratory, Chofu, Japan), HIROSHI WAKAI, TADASHI ISHIKAWA, and KOUHEI TANAKA (Fuji Heavy Industries, Ltd., Aerospace Div., Utsunomiya, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 182-185. In Japanese. refs

During the reentry of a spaceplane, it is necessary to use a reaction control system (RCS) for attitude control augmentation in flight regions where the control surfaces are not fully effective. A shock tunnel experiment was performed on aerodynamic interference induced by RCS jets in hypersonic flow in order to establish test techniques and to understand basic characteristics of aerodynamic interference of a delta-winged spaceplane with tipfins.

Author

A92-56044

BGK1 AIRFOIL OILFLOW TESTS IN THE NAL TWO-DIMENSIONAL WIND TUNNEL. II

MAMORU SATO, HIROSHI KANDA, NORIKAZU SUDANI, SHIGEO BABA, HITOSHI MIWA, and KENICHI MATSUNO (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 190-193. In Japanese. refs

Oilflow visualization tests were conducted to investigate sidewall boundary-layer effects on models with different aspect ratios in a 2D wind tunnel. Tests with sidewall boundary-layer suction were also conducted. Aspect ratios of the models were 1.2, 1.5, and 2.5, and the Reynolds number based on the airfoil chord was 21×10^6 . The flows on the BGK1 airfoil models are grouped into four patterns. At high angles of attack and/or Mach numbers over 0.75 (the design point), shock-wave behavior becomes completely 3D, and a pair of vortices appears on the airfoil surface.

Author

A92-56045

HIGH SUBSONIC WIND TUNNEL TEST OF A TWO-DIMENSIONAL HYBRID-LAMINAR-FLOW-CONTROL AIRFOIL WITH SLOTTED SURFACE

YOJI ISHIDA, MASAYOSHI NOGUCHI, MAMORU SATO, and HIROSHI KANDA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 194-197. In Japanese.

A wind-tunnel test in high-subsonic and high-Reynolds-number flows was made for a 2D hybrid-laminar-flow-control airfoil with slotted surface suction to study the drag-reduction effect of the airfoil. The Mach number was varied from 0.6 to 0.86 and Reynolds number from 8 to 20 million. It was found that the net drag reduction as high as 7 percent was realized for these conditions. Author

A92-56046

EXPERIMENTAL INVESTIGATION OF THE BOUNDARY LAYER IN A CORNER FORMED BY TWO CIRCULAR ARC AIRFOILS

MUTSUO KOTAKE, TADASHI MIKAMI, and YASUHIKO TANAKA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 198-201. In Japanese. refs

A corner boundary layer which is formed by two circular-arc airfoils of the same shape intersecting at right angles to each other was investigated experimentally. The properties of the corner flow with pressure gradient was obtained from velocity profiles, lines of equal velocity, and other quantities. Author

A92-56047

DESIGN AND WIND TUNNEL TEST OF LOW-REYNOLDS-NUMBER AIRFOIL

HIDEHIRO HIROSE and TETSUO YAMAZAKI (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 202-205. In Japanese. refs

A low-Reynolds-number airfoil design for an unmanned high-altitude vehicle is presented. The wind tunnel test of the FLA1M airfoil is discussed, and wing shape and pressure distribution on the wing surface are examined. Y.P.Q.

A92-56048

NUMERICAL SIMULATION OF SUPERSONIC UNSTEADY FLOW USING A PANEL METHOD

YUICHI OKAYAMA and TERUO SAWADA (Okayama University of Science, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 218-221. In Japanese. refs

A panel method for unsteady supersonic flows is developed. The outline of the theoretical formulation and the numerical procedure is given, and the results of calculations of flows around oscillating cones and wings are reported. The fundamental formulation is based on Morino's method, the application of which to unsteady supersonic flows is realized in the present work.

Author

A92-56049

CALCULATIONS OF AERODYNAMIC FORCES ON A WING WITH THRUST USING B.E.M

MITSUNORI YANAGIZAWA (Tokyo, Science University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 222-225. In Japanese. refs

This paper presents a BEM for wings with thrust in potential flow. The effect of thrust is represented by doublet singularities. The method employs an aerodynamic panel code to simulate the flow of fan jet stream around an aircraft configuration. A configuration of a VTOL transport in a multijet lifting system is composed of lifting fans nested in the wing planform. The aerodynamic forces was calculated with the fundamental shape

02 AERODYNAMICS

of fan in wing. The result is that there are regions of negative lift behind the position of the lift fan on which they interact with the wing to produce the aerodynamic forces. Author

A92-56050

GENERALIZED AERODYNAMICS ANALYSIS BY THE BOUNDARY ELEMENT METHOD

MITSUNORI MATSUSHITA, KENJI FUJII, and MITSUNORI YANAGIZAWA (Tokyo, Science University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 226-229. In Japanese. refs

The computer code for analyzing rigid-body oscillating aerodynamic forces by the boundary element method (the panel method) is extended to compute the generalized aerodynamic forces for oscillating aircraft. The boundary condition portions of the original program are modified to adapt to the results of the FEM vibration analysis. Some example calculations for the flexible wing are shown. Author

A92-56052

ON THE EFFECT OF CANARDS ON NAL SPACEPLANE MODEL (0 ORDER) IN LOW SPEED AREA

SEIZO SUZUKI, HIROHUMI KONDO, HIDEO HOSINO, and MASAOKI YANAGIHARA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 234-237. In Japanese. refs

This paper describes on effect of NAL spaceplane model with canards in low speed areas. The static wind-tunnel test of the spaceplane model was conducted in the NAL Low-speed Wind Tunnel (5.5 M x 6.5 M). Canards were effective to improvement of CLmax, L/D, Cn-beta, CL-delta e, and Cm-delta(e). Author

A92-56053

MOTION ANALYSIS OF 2-DIMENSIONAL FLAT PLATE IN GROUND EFFECT

KYOKO NITTA and HIROBUMI OHTA (Nagoya University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 238-241. In Japanese. refs

Some analysis of the instability of aircraft flying in the ground effect, which is the aerodynamic effect with proximity to the ground, is shown in this report. In most cases, ground effects work favorably, as is typically seen for ACV. We calculated some cases using a finite difference method modified from NASA Ames code LTRAN2, changing the parameters concerning the aeroelastic feature of the motion of the airfoil. Only the cases of 2D flat plate are dealt with this time. Author

A92-56054

LOW-SPEED WIND TUNNEL TESTING FOR THE HIGH-SPEED PROPELLER AT HIGH SHAFT ANGLE OF ATTACK

MASATAKA HASHIDATE and SHIGERU SAITO (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 242-245. In Japanese. refs

The high-speed propeller characteristics at high shaft angle of attack is measured in a large-scale low-speed wind tunnel. The propeller (SR-3) was run over a range of blade setting angles from 40 to 50 deg, rotor speed from 1000 to 1600rpm, and wind speed from 0 to 45 m/s. The results obtained are as follows. (1) Theoretical predictions by local circulation method are in good agreement with measurements. (2) The thrust and power coefficient correspond to each other when plotted by perpendicular velocity to the rotor rotational plane. Author

A92-56058

A PHYSICAL APPROACH TO THE ESTIMATION OF AERODYNAMIC CHARACTERISTICS FROM FLIGHT DATA

OSAMU KOBAYASHI and FUMIKAZU KAINUMA (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th,

Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 258-261. In Japanese. refs

Flight data are given for the estimation of aerodynamic characteristics. The equation error method and the output error method are distinguished. Y.P.Q.

A92-56078

A LOW SPEED WIND TUNNEL INVESTIGATION OF A JOINED-WING AIRCRAFT WITH AN OVERHANGING FIN

AKIHITO IWASAKI, TOSHIMI FUJITA, HIROTOSHI FUJIEDA (National Aerospace Laboratory, Chofu, Japan), HISASI SATO (Tokai University, Japan), and NAOTO TAKIZAWA IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 346-349. In Japanese.

The aerodynamic characteristics of a joined-wing aircraft are presented. The lift, drag, and pitching moment coefficients, the side force rolling moment, and the yawing moment coefficients are analyzed. Y.P.Q.

N92-10009# National Aerospace Lab., Tokyo (Japan).

NUMERICAL SIMULATION OF HYPERSONIC VISCOUS FLOW FOR THE DESIGN OF H-2 ORBITING PLANE (HOPE-2)

YUKIMITSU YAMAMOTO and TOSHIO AKIMOTO Jan. 1991 78 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1093) Avail: CASI HC A05/MF A01

An unmanned winged vehicle for space transportation, the H-II Orbiting Plane (HOPE), is being studied. Hypersonic computational fluid dynamics (CFD) analyses were performed on the proposed HOPE '63 model, with the effects of Reynolds number, Mach number, angles of attack, and yaw angles. In order to use CFD for more practical design purposes, analyses of control surfaces and the gas jet are also discussed. The objectives were to: (1) demonstrate the numerical code's validity for aerothermodynamic heating; (2) investigate the applicability of CFD to control problems; and (3) utilize CFD as the main design tool of the HOPE configuration, i.e., utilize it as a numerical wind tunnel. Numerical simulations were conducted using the flux split upwind Navier-Stokes code, and results showed excellent agreement with heat transfer distribution experiments, thereby demonstrating the present code's validity. Author

N92-10980# National Aerospace Lab., Tokyo (Japan). Airframe Div.

UNSTEADY AERODYNAMIC CALCULATIONS FOR GENERAL CONFIGURATIONS BY THE DOUBLE-POINT METHOD

TETSUHIKO UEDA Apr. 1991 31 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1101T) Avail: CASI HC A03/MF A01

A method for predicting unsteady aerodynamic loadings on general configurations is presented. The procedures are based on the lifting surface theory, with the time variable being transformed to the Laplace domain so that the calculation is valid in the region of off axis from the frequency domain. The results are subsequently compared with those from other methods and experiments in both the subsonic and supersonic frequency domains. In addition, a generalized force is calculated in the Laplace domain for a rectangular wing in supersonic flow. Author

N92-17755# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

RESULTS OF MEASURED TEMPERATURE DISTRIBUTION ON AN ADIABATIC WING MODEL WITH RADIATION THERMOMETER [HOSHA ONDOKEI NIYORU

DANNETSUYOKU MOKEIJO NO ONDO BUNPU SOKUTEI SHIKEN KEKKA]

HIDEO SAWADA, AKIRA KOIKE, KOICHI SUZUKI, YUKIO KOMATSU, SEIGO NAKAMURA, and SHIGEO BABA Jul. 1989 31 p In JAPANESE

(ISSN 0452-2982)

(NAL-TM-610; JTN-92-80246) Avail: CASI HC A03/MF A01

In order to evaluate the influence of the wind tunnel difference upon the wind tunnel test result, it is necessary to evaluate the influence of the disturbance of the stream upon the boundary layer, detachment area, and disturbance area on the wind tunnel model. It is necessary to measure the transition point of boundary layer on the wing. As there is a close relationship between the boundary layer and the temperature distribution of the wing, it is effective to examine the temperature distribution on the wing in order to study the stream on the wing. This paper describes the measurement of the temperature distribution on an adiabatic wing model by the non-contact thermometer and shows the observation results on the shockwave location, detachment area, and transition point location on the wing.

Author (NASDA)

N92-18239# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

AN IMPROVED METHOD FOR SIMULATING SUPERSONIC FLOW PAST A WEDGE SHAPED BODY

KUNIO NOMIZO Feb. 1991 18 p In JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1097) Avail: CASI HC A03/MF A01

Several reports have obtained numerical solutions for supersonic flow past blunt nosed body, and in every case the method adopted can be described as an inverse marching process. This method was applied to a wedge shaped body, thus requiring an elliptical type equation to be solved. To facilitate the solution process, the pressure and density terms are eliminated from the equation so that it is composed solely of velocity terms. An initial application is discussed which constructs the solution starting from shock waves, the Taylor maccolli solution, with satisfactory results being obtained.

Author

N92-18484# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

AN APPROACH TO FLOW FIELD MEASUREMENT BY LASER 2-FOCUS VELOCIMETER (L2F) IN GUST WIND TUNNEL [TOPPU FUDOYO REZA 2 SHOTEN RYUSOKUKEI O MOCHIITA NAGAREBA KEISOKU NO KOKOROMI]

KENICHI RINOIE, TOSHIMI FUJITA, AKIHITO IWASAKI, and HIROTOSHI FUJIEDA Mar. 1990 25 p In JAPANESE

(ISSN 0452-2982)

(NAL-TM-617; JTN-92-80289) Avail: CASI HC A03/MF A01

This report introduces the laser dual focus velocimeter of National Aerospace Laboratory (NAL) gust wind tunnel. The background, measurement theory, instruments configuration, data processing flow, and measurement error of this velocimeter are presented in the report. To present the accuracy and problems in using this velocimeter, some measurement results, such as the wind tunnel flow and stream line, are shown in this report.

Author (NASDA)

N92-21287# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

EVALUATION OF NACA0012 AIRFOIL TEST RESULTS IN THE NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL

NORIKAZU SUDANI, HIROSHI KANDA, MAMORU SATO, HITOSHI MIWA, KENICHI MATSUNO, and SUSUMU TAKANASHI May 1991 18 p

(ISSN 0389-4010)

(NAL-TR-11097; PB92-178862) Avail: CASI HC A03/MF A01

Surface pressure and drag measurements on the NACA0012 airfoil were conducted in the NAL Two-Dimensional Transonic Wind Tunnel. Using a comparison with other wind tunnel data, the wall interference effects are discussed, especially those from the sidewall. The results suggest that the Mach number of the actual flow around the airfoil is lower than the setting Mach number. The Mach number correction for the sidewall boundary layer effects based on the similarity rule was applied to the present measurements, thereby showing that the shock positions, the pressure distributions, and the minimum drag coefficients are in

good agreement with both other wind tunnel results and the Navier-Stokes calculation. It is shown that the evaluation indicates satisfactory transonic airfoil test results in the NAL Two-Dimensional Transonic Wind Tunnel.

Author

N92-25366# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

STATIC AEROELASTIC ANALYSIS OF ACT WIND TUNNEL MODEL AIRCRAFT [ZENKI ACT FUSHI MOKEI NO SEITEKI KURIKI DANSEI KAISEKI]

HIROSHI MATSUSHITA, KENJI FUJII, TETSUHIKO UEDA, and MITSUNORI YANAGISAWA Jul. 1990 17 p In JAPANESE

Original contains color illustrations

(ISSN 0452-2982)

(NAL-TM-624; JTN-92-80312) Avail: CASI HC A03/MF A01

As a part of research activities on ACT (Active Control Technology) at NAL, wind tunnel tests on the ACT wind tunnel model aircraft with elastic wings were performed to investigate the effect of rigid body movement mode to gust load alleviation effects. The mathematical model of the ACT wind tunnel model aircraft was to be constructed to design the control rule of gust load alleviation. Accordingly, the related data were to be obtained by vibration tests and by wind tunnel tests. The mathematical model was to be examined using an analytical method. In the beginning, the structural analysis model using Finite Element Method (FEM) was constructed based on the measurement results of rigidity distribution, mass distribution, and inertia moment distribution. The mathematical model on structural characteristics was derived with the adjustment of the structure parameters obtained from vibration tests. The static deformation analysis method is the mathematical model obtained by the combination of the aerodynamic analysis software. The data obtained from the static aerodynamic elasticity analysis is compared with the wind tunnel test results. The inclusion of elastic effects was found to improve the correlation of analysis results with the wind tunnel test results. Details of the analysis results are reported.

Author (NASDA)

N92-28151# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

NACA0012 AIRFOIL DATA CORRECTED FOR SIDEWALL BOUNDARY-LAYER EFFECTS IN THE NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL

NORIKAZU SUDANI, HIROSHI KANDA, MAMORU SATO, SHIGEO BABA, HITOSHI MIWA, and KENICHI MATSUNO Sep. 1991 75 p

(ISSN 0452-2982)

(NAL-TM-640T; JTN-92-80377) Avail: CASI HC A04/MF A01

An experimental study of NACA0012 airfoils at transonic speeds was conducted in order to acquire aerodynamic data for evaluating sidewall boundary layer effects. Measurements primarily consisted of static pressure on the airfoil and drag force coefficients determined using the wake rake. The tests were performed at free stream Mach numbers from approximately 0.65 to 0.8, at angles of attack from -2.0 deg to 2.0 deg, and at Reynolds numbers (based on airfoil chord) from 7(10)(exp 6) to 40(10)(exp 6). Mach number corrections for sidewall boundary layer effects were made, and tests were subsequently performed on two different chord airfoils to confirm the applicability of the correction to different airfoil aspect ratios. This is a supplementary report; it presents both uncorrected and corrected data which enables comparative studies to be conducted using computational fluid dynamics and other wind tunnel experimental results.

Author (NASDA)

N92-28152# National Aerospace Lab., Tokyo (Japan). Control Systems Div.

ESTIMATION OF CABLE-MOUNTED MODEL INERTIA CHARACTERISTICS FOR DYNAMIC WIND-TUNNEL TEST

MASAAKI YANAGIHARA, MASAHIKO NAGAYASU, SHUICHI SASA, and TAKASHI SHIMOMURA Oct. 1991 43 p In JAPANESE; ENGLISH summary

(ISSN 0452-2982)

(NAL-TM-641; JTN-92-80378) Avail: CASI HC A03/MF A01

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The inertia characteristics of a cable mounted spaceplane model (1:20 scale), that is used for dynamic wind tunnel tests, were experimentally estimated. The estimated parameters consisted of the vertical position of the model's center of gravity, the inertia moments $I(\text{sub } x)$, $I(\text{sub } y)$ and $I(\text{sub } z)$, and the product of inertia $I(\text{sub } xz)$. The method was based on a bifilar pendulum system and estimation errors were evaluated. As a result, the moment of inertia $I(\text{sub } y)$ and $I(\text{sub } z)$ were estimated within approximately ± 1 percent error, although $I(\text{sub } x)$ and the product of inertia $I(\text{sub } xz)$ had larger errors. An analysis of the estimation error confirmed that the errors for $I(\text{sub } x)$ and $I(\text{sub } xz)$ can be improved by using a smaller suspension rig. Author (NASDA)

N92-28190# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

FORCE MEASUREMENTS ON AGARD CALIBRATION MODEL-B AT TRANSONIC SPEEDS IN THE NAL TWO-DIMENSIONAL WIND TUNNEL

MAMORU SATOU, HIROSHI KANDA, NORIKAZU SUDANI, SHIGEO BABA, HITOSHI MIWA, and IWAO KAWAMOTO Aug. 1991 15 p In JAPANESE; ENGLISH summary (ISSN 0552-2982)

(NAL-TM-639; JTN-92-80376) Avail: CASI HC A03/MF A01

In order to investigate the capability of conducting force measurements of three dimensional (3-D) models in NAL's two dimensional (2-D) wind tunnel, force measurements on AGARD calibration Model-B (Mach numbers: from 0.5 to 1.1, Reynolds number: 3×10^6 and 4×10^6). Full and half models were tested. Four different strut lengths having a circular arc cross section and stings were used to install the full model. For the half model, a plate was installed to remove the effects of the wind tunnel's sidewall boundary layer, as well as adding a small gap between the model and the plate to remove the effects of the plate's boundary layer. It was shown that force measurements of 3-D models are possible in NAL's 2-D wind tunnel, although improvements in the struts and stings are necessary to conduct tests at Mach numbers greater than 0.85. Author (NASDA)

N92-28192# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

A GUST GENERATION METHOD FOR FULL CONFIGURATION AIRCRAFT TESTS IN A LOW SPEED WIND TUNNEL. PART 1: DESIGN AND PRELIMINARY EXPERIMENTS

SEIZOU SUZUKI, SIGEO KAYABA, TADAO SAWAI, and NORIMASA YOSHIDA Jun. 1991 40 p In JAPANESE In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1115-PT-1; JTN-92-80383) Avail: CASI HC A03/MF A01

A gust generation method is described that uses vortices produced from four oscillating cantilever wings which were installed in a low speed wind tunnel upstream of the test section. In order to obtain uniform pulsating flow at the test model, the aspect ratio of the rectangular wings was theoretically determined. Preliminary experiments validation were performed in a pilot tunnel with results indicating a suitable design method which is appropriate for application in NAL's 6.5 m x 5.5 m Low Speed Wind Tunnel.

Author (NASDA)

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A92-11014#

HUNTING PHENOMENA OF THE BALLOON MOTIONS OBSERVED OVER ANTARCTICA

JUN ISHIMURA (Institute of Space and Astronautical Science,

Sagamihara, Japan) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 83-88. refs (AIAA PAPER 91-3667) Copyright

It was reported that strong hunting motions were observed just after reaching the ceiling altitude for the balloons launched in Antarctica in the daytime. Such hunting motions have been observed over midlatitudes only for night time launching. In this paper, the thermal analysis of the balloon motions is performed by considering the atmospheric temperature and environmental radiation conditions at balloon altitudes. It is found that the hunting phenomena in summer season are caused by the fact that the balloons over Antarctica encounter similar thermal conditions to those flights at night over the midlatitudes. Author

A92-11031#

POLAR PATROL BALLOON

T. HIRASAWA, M. EJIRI, R. FUJII, A. KADOKURA (National Institute of Polar Research, Tokyo, Japan), J. NISHIMURA, N. YAJIMA, M. AKIYAMA, T. YAMAGAMI, S. OHOTA (Institute of Space and Astronautical Science, Sagamihara, Japan), and S. KOKUBUN (Tokyo, University, Japan) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 205-208. refs (AIAA PAPER 91-3688) Copyright

From late December of 1990 to early January of 1991, the National Institute of Polar Research, in collaboration with the Institute of Space and Astronautical Science, launched two large zero-pressure balloons from Syowa Station which is the Japanese research base in Antarctica. The balloon launched on December 25 returned near Syowa Station after 15 days of flight keeping the constant altitude of about 30 km. It finally accomplished almost a one and half a circumpolar flight. The total flight duration was about 40 days. This paper will describe the balloon system and the flight behavior of the balloon. Author

A92-38207

PROSPECTS FOR A COMMERCIAL STOL TRANSPORTATION SYSTEM

JUNICHI MIYASHITA (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 54-65. In Japanese.

The development and flight test of the experimental STOL aircraft ASUKA for a commercial transportation system are presented. The direct operating costs of STOL aircraft for commercial transportation are analyzed. The results of the investigation of the transportation system including equipment requirements are outlined. Y.P.Q.

A92-38208

THE HELICOPTER COMMUTER - A PERSPECTIVE ON REGULAR PASSENGER TRANSPORTATION BY ROTARY WING

MICHEL J. MANTIN IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 66-75.

A development history and current economic viability evaluation is conducted for a scheduled-flight commercial helicopter commuter system, based on the S-61, 24-32 seat-equipped vehicle. A comparative study is made of the operating costs of tilt-rotor, helicopter, and conventional commuter aircraft. It is noted that helicopters and tilt-wing aircraft can play a complementary role in the furnishing of commuter time-saving, albeit at slight increase in flight costs. Success of helicopter commuting depends on comprehensive, industry/government/airline operator coordination in vehicle development. O.C.

A92-43155

NAVIGATION PREPARATIONS FOR PASSENGER HELICOPTERS

M. SUGANO (City Airlink, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 280-283. In Japanese.

The configuration of the BELL412 helicopter and preparation modes such as the condition monitoring modes are presented. Maintenance plans including aircraft scheduled inspection and engine periodic inspection are discussed. The navigational schedule for the Narita, Haneda and Yokohama airports is discussed.

Y.P.Q.

A92-43161

A HELICOPTER TRANSPORTATION SYSTEM

CHOJI TOMITA (City Airlink, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 306-309. In Japanese.

The use of helicopters for passenger and cargo transportation is discussed. Urban airlink development is addressed, and problems such as safety, noise, and air traffic control are discussed.

Y.P.Q.

A92-43162

USING HELICOPTERS FOR THE ERECTION OF POWER TRANSMISSION LINES

S. IZUMIDA (New Japan Helicopter Co., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 310-313. In Japanese.

A92-43163

HELICOPTERS FOR PUBLIC SERVICES, INCLUDING RESCUE, FIRE FIGHTING, AND MEDICAL EMERGENCY

YASUO TANAKA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 314-317. In Japanese.

The use of helicopters for police patrol, and traffic information collection, and fire fighting is addressed. Using helicopters for medical emergency services is also discussed. A statistical analysis of these applications of helicopters in Germany, Switzerland, and the United States is presented.

Y.P.Q.

A92-43164

USING HELICOPTERS FOR COASTAL ALERT

A. KOBE and N. IWAMURA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 318-321. In Japanese.

The role of helicopters in coastal alert is discussed. The characteristics and structures of a new antisubmarine (XSH-60J) system are examined. The in-flight performance monitor system is reported.

Y.P.Q.

A92-43219

AIRCRAFT ACCIDENTS AND HUMAN FACTORS

S. MURAKAMI and HIDETAKE SAKUMA (Japan Airlines; Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 540-543. In Japanese.

Factors involved in aircraft accidents are discussed. Pilot evaluations are emphasized, and the NASA Aviation Safety Reporting System (ASRS) is introduced.

Y.P.Q.

A92-45426

ON THE POSSIBILITY OF FREEZING AND STICKING PHENOMENA IN A TRANSPORT DURING THE GROUND TAXIING AND TAKEOFF RUN AND ON THE PREVENTIONS OF THE HAZARD

KINGO TAKSAWA (National Aerospace Laboratory, Tokyo, Japan) and MITSUO SAKA (Japan Air System, Tokyo) IN: International

Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 569-580. refs

(SAE PAPER 912042) Copyright

In the present analytical study of slush-sticking and freezing phenomena associated with the tail surfaces of a commuter airliner during ground operations, a simple model describing outflows of heat from slush to the surrounding airflow, involving both conduction and evaporation, has given attention to meteorological and operational conditions' effects on the heat-transfer rate. Also noted is the effect of the spraying of aircraft deicing fluid, as reflected by a survey of pilots' experiences.

O.C.

N92-18182# National Aerospace Lab., Tokyo (Japan).

INVESTIGATION ON FREEZING AND STICKING PHENOMENA OF SLUSH ON AIRPLANE SURFACES WHEN TAXIING ON THE GROUND AND THE SUCCEEDING TAKE-OFF RUN PHASE

KINGO TAKAGAWA and FUMIKO ITO Aug. 1989 20 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1026) Avail: CASI HC A03/MF A01

An analytical study was conducted on the freezing and sticking phenomena of slush on the horizontal tail surfaces of a twin turboprop transport in the ground taxiing and takeoff run phase. A simple mathematical model describing the outflow of heat from slush to the surrounding airflow through the boundary layer is proposed. Both the conductive heat transfer and the heat transportation accompanied by the evaporation of water from slush are taken into account. The influences upon the heat transfer rate caused by climatic and operational conditions such as the atmospheric temperature, dew point, ground speed, suction coefficient over the horizontal tail surfaces, propeller slip stream effects, and the roughened surface covered by the slush are quantitatively evaluated. Under the climatic conditions occasionally experienced by airline operations in winter, the outflow of heat sufficient to stick the elevators is predicted for the 5-minute ground operation after the starting of the engines and the following 25 second takeoff. During the course of analysis, the conditions which cause, and the factors which accelerate, the freezing of slush are defined.

Author

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A92-17242

RANGING AND POSITIONING EXPERIMENTS FOR AIRCRAFT USING ENGINEERING TEST SATELLITE V

K. ITO (Ministry of Transport, Electronic Navigation Research Institute, Mitaka, Japan) IEE Proceedings, Part F: Radar and Signal Processing (ISSN 0956-375X), vol. 138, Dec. 1991, p. 571-575. Research supported by Communications Research Laboratory, Japan Air Lines Co., Ltd., and NASDA. refs Copyright

The paper describes a ranging and positioning system using two geostationary satellites, one real and one pseudo on the ground, and gives the results of experiments. The system is designed to allow ranging and positioning of each aircraft every 0.6 s with a ranging and positioning accuracy of 100 m and 1 km, respectively. Experiments to estimate the system were performed using two aircraft: a Boeing 747 on the north Pacific route with a satellite elevation angle (EL) of about 20 deg, and a Beechcraft B99 in the domestic area of Japan with an EL of about 47 deg. The random error of the range was about 50 m in the experiment on the north Pacific route. The difference between the position of

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the B99 obtained with this system and that obtained with the global positioning system was about 500 m in the experiment in the domestic area of Japan. Author

A92-26780

HIGH GAIN AIRBORNE ANTENNA FOR SATELLITE COMMUNICATIONS

SHINICHI TAIRA, SHINGO OHMORI, and MASATO TANAKA
Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 39-46. In Japanese. refs

The development and experimental test results of a high gain airborne antenna for satellite communications are presented. The characteristics of the antenna as installed on a commercial jet aircraft and tested on transoceanic flight routes are described.

R.E.P.

A92-40187

EXPERIMENTS ON AERONAUTICAL SATELLITE COMMUNICATIONS USING ETS-V SATELLITE

YOSHIHIRO HASE, HIROMITSU WAKANA, SHINICHI TAIRA, and SHINGO OHMORI
Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 191-203. refs

Copyright

Through many research and development activities by many countries and organizations all over the world, aeronautical satellite communications will be implemented on a commercial basis within the coming one or two years. This paper describes the world's first aeronautical satellite communication experiments conducted in L-band frequencies using a commercial aircraft. A newly developed airborne antenna having electronically steerable beams, and communication equipment were installed in a B-747F freighter flying over transoceanic flight routes. The satellite used in these experiments is the Engineering Test Satellite-five (ETS-V). During the test period, various experiments were conducted such as antenna pattern measurements, transmission performances and voice quality evaluation. As the airborne antenna is the key component for the aeronautical satellite communication system, an emphasis has been placed on antenna characteristics. Its performances are closely related to the fading characteristics in low elevation areas and to transmission error performances.

Author

A92-40188

HIGH GAIN AIRBORNE ANTENNA FOR SATELLITE COMMUNICATIONS

SHINICHI TAIRA, MASATO TANAKA, and SHINGO OHMORI
Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 205-216. refs

Copyright

The performance of the world's first airborne phased array antenna is described. The antenna is compact, lightweight, has a wide frequency bandwidth, and a low axial ratio in wide scanned angles, which is realized by a sequential array technique. The antenna was tested on board a commercial jet airliner using the ETS-V satellite and was shown to meet both the electrical and the mechanical standards required for aeronautical satellite communications.

S.A.V.

A92-43122

NAVIGATION EXPERIMENT ON AN AIRCRAFT USING THE GPS-INS NAVIGATION SYSTEM. I - INTRODUCTION TO THE SYSTEM

HIROKIMI SHINGU, HIROICHI MATSUSHIMA, TADAO UCHIDA (National Aerospace Laboratory, Chofu, Japan), MASARU OKA, MASAYUKI IKEUCHI, and SHOWA HARIGAE (Toshiba Corp., Kawasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 136-139. In Japanese. refs

The system structures of the Global Positioning System (GPS) and the inertial navigation system (INS) are presented. The gyro drift stability is evaluated. The structural element performance and characteristic tests are outlined.

Y.P.Q.

A92-43123

NAVIGATION EXPERIMENT ON AIRCRAFT FLIGHT USING THE GPS-INS NAVIGATION SYSTEM. II - TEST RESULTS

SHOWA HARIGAE, Y. MAEDA (Toshiba Corp., Kawasaki, Japan), KOJI ONO, W. ISHIGAWA, and HIROKIMI SHINKU (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 140-143. In Japanese.

Fixed point calculation is given and test results are evaluated for a GPS/INS navigation experiment. The position, velocity, and altitude errors of the GPS-INS navigation system are analyzed.

Y.P.Q.

A92-43207

EVALUATION OF AN INERTIAL SENSOR WITH AEROPHOTOGRAPHY

TADAO UCHIDA, TAKATSUGU ONO, and KAZUTOSHI ISHIKAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 492-495. In Japanese. refs

The testing system structure for the evaluation of INS position errors is presented. The photographic system is introduced; it includes a photographic monitor and data recording equipment. An error analysis is presented.

Y.P.Q.

A92-55944

EXPERIMENTS ON AERONAUTICAL SATELLITE COMMUNICATIONS USING ETS-V SATELLITE

SHINGO OHMORI, YOSHIHIRO HASE, HIROMITSU WAKANA, and SHINICHI TAIRA (Communications Research Laboratory, Koganei, Japan) (Transl. of Communications Research Laboratory, Review, vol. 36, no. 10, Mar. 1990, p. 27-37) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 28, no. 3, July 1992, p. 788-796. Previously cited in issue 10, p. 1594, Accession no. A92-26779. refs

Copyright

A92-56081

HEIGHT KEEPING PERFORMANCE REQUIREMENTS FOR REDUCING VERTICAL SEPARATION MINIMA USED FOR AIR TRAFFIC CONTROL

SAKAE NAGAOKA (Electronic Navigation Research Institute, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 362-365. In Japanese. refs

The Review of the General Concept of Separation Panel of the ICAO concluded that the reduction of the current 2000-ft vertical separation minimum to 1000 ft was technically feasible at or above 29,000 ft altitude. Recently, the Panel developed a guidance material for its implementation. This paper briefly describes the Panel's works and height-keeping performance requirements.

Author

A92-56088

HISTORY OF AERONAUTICAL SATELLITE COMMUNICATIONS

SHINGO OHMORI (Communications Research Laboratory, Koganei, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 398-401. In Japanese. refs

The history of aeronautical satellite communications is introduced. The trends of aeronautical satellite communications, such as air traffic control, aeronautical operational communication, and aeronautical passenger communications are discussed, and the AvSAT plan is addressed.

Y.P.Q.

A92-56089

AERONAUTICAL SATELLITE COMMUNICATIONS SYSTEM

TOSHIRO KOJIMA (Kokusai Denshin Denwa Co., Ltd., Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings.

Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 402-405. In Japanese.

Communications between aircraft and ground stations have employed HF and VHF bands. UHF band is also used to provide public telephone services on domestic flights. Their service quality or coverage is limited for airliners flying long distances. An aeronautical satellite communications system has been developed as innovative air-ground communications system, and inflight service trials through the Inmarsat satellite were carried out on B-747 passenger airplane in 1987-1988 and 1990. Aeronautical low-rate data communication services were commenced in December 1990 and will provide aeronautical voice services in 1991 on the Pacific Ocean region through the Inmarsat system. This paper presents an aeronautical satellite communications system composed of airborne and ground equipment and space segment. Author

A92-56090

A DATA PROCESSING SYSTEM FOR OCEANIC AIR TRAFFIC CONTROL

HIROKI SATO (Electronic Navigation Research Institute, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 406-409. In Japanese.

The Oceanic Air Traffic Control Data Processing System (ODP) is described. ODP predicts an aircraft's movement by analyzing its flight plan data and displays information such as an aircraft's call sign, position, altitude, and flight route as reported by high frequency radio link on a 20 in x 20 in flat video display terminal. C.D.

A92-56091

AIRCRAFT SATELLITE COMMUNICATION SYSTEMS

YOSHINORI SEINO (Toshiba Corp., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 410-413. In Japanese.

An aircraft earth station (AES) system of aircraft satellite communications is presented. The communication service channels for signal link control are introduced, such as the packet mode time division multiplex channel, the random access channel reservation TDMA channel, and the circuit mode SCPC voice channel. The AES components and their configurations are discussed. Y.P.Q.

A92-56092

EVALUATION REPORT OF AN EXPERIMENTAL SATCOM OPERATION BY A JAPAN AIRLINE'S B747 PASSENGER PLANE

KEIICHI TSUCHIYA (Japan Airlines Co., Ltd., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 414-417. In Japanese.

An inflight Satcom service trial was carried out through the Inmarsat system utilizing a Japan Airline's B747 passenger plane. A total of three digital voice/fax communication channels for Aeronautical Operational Communication, Aeronautical Administrative Communication, and Aeronautical Passenger Communication were established simultaneously by utilizing the class-A linear high power amplifier and the combination of 9.6/4.8 Kbps voice codes. Through the trial, the voice quality of 4.8 Kbps voice code was recognized as satisfactory for the application for aeronautical satellite communication. Author

A92-56093

AN EXPERIMENTAL PROGRAM CONCERNING A SATELLITE DATA LINK FOR OCEANIC ATC

KENJI NIIMI, AKIRE ISHIDE, MITSUHIRO FUJITA, KIYOSHI YUKAWA, and MASAHICO OONUMA (Electronic Navigation Research Institute, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 418-421. In Japanese. refs

The concept of satellite data link research is discussed. Automatic dependent surveillance (ADS) data communication is discussed, and the structures of research aircraft on-board equipment and the ground station facility are addressed. Y.P.Q.

A92-56110

A CONSIDERATION ON AIR TRAFFIC CONTROL PROCESSING CAPABILITY IN TERMINAL AREA

SACHIKO ONOZUKA, TSUKASA MATSUURA, TORU UENO, and NORIYASU TOFUKUJI (Electronic Navigation Research Institute, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 494-497. In Japanese.

A demand for aviation has been increasing, therefore the air traffic control (ATC) system has to handle more traffic. However, there is the limit of traffic handling capability due to the controller's workload, i.e., ATC processing capability. An ATC simulation experiment in a terminal area was conducted for arrivals to examine its capability. This paper discusses the traffic handling capability in terms of the number of simultaneously controlled aircraft and communications between controllers and pseudopilots, which were analyzed using the results of two representing scenarios. Author

A92-56116

FLIGHT EVALUATION OF NAVIGATION SYSTEMS INCLUDING MLS USING NAL DO228 - OUTLINE

TAKATSUGU ONO, TOSHIHO SAKAI, YOSHIKAZU MIYAZAWA, MASAKI MURATA, AKIRA TADA, KENJI FUJII, YUKIO KAMATA, YUSHI TERUI, MASARU NAKAMURA, TADAO UCHIDA (National Aerospace Laboratory, Chofu, Japan) et al. IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 520-523. In Japanese. refs

At Sendai Airport, flight evaluation tests of navigation systems (MLS, DME/P, GPS, INS and Radio Altimeter) were conducted with NAL Do228. Reference flight path data were obtained by an ENRI laser tracking system. This paper describes the outline of the flight tests, equipment, flight data acquisition system, and laser tracking data processing. Author

A92-56117

FLIGHT EVALUATION OF NAVIGATION SYSTEMS INCLUDING MLS USING NAL DO228 - RESULTS OF MLS

TAKATSUGU ONO, YOSHINORI OKUNO, TOSHIHARU INAGAKI, YOSHITAKA MURAKAMI (National Aerospace Laboratory, Chofu, Japan), HIROHISA TAJIMA (Electronic Navigation Research Institute, Tokyo, Japan), HIROSHI IIDA, and KENICHI SHIRAKAWA (NEC Corp., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 524-527. In Japanese. refs

Flight tests for landing navigation aids including MLS were conducted with a NAL research airplane at Sendai Airport. The results are briefly reported in this paper, such as the MLS coverage and 6-degree glide path performance. The measurement data for azimuth, elevation, DME/P, and radio altitude were recorded with an onboard flight data acquisition system and afterwards compared with laser tracker's reference position data. Author

A92-56118

FLIGHT EVALUATION OF NAVIGATION SYSTEMS INCLUDING MLS USING NAL DO228 - RESULTS OF GPS

KAZUTOSHI ISHIKAWA, KOKI HOZUMI, TOSHIHARU INAGAKI, HIROKIMI SHINGU (National Aerospace Laboratory, Chofu, Japan), SOUNOSUKE FUKUSHIMA (Electronic Navigation Research Institute, Tokyo, Japan), MASAYUKI IKEUCHI, MASATOSHI HARIGAE, and HIROSHI TOMITA (Toshiba Corp., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 528-531. In Japanese. refs

In 1990, navigation systems including MLS has been flight tested at Sendai airport, Japan. A civil code single-channel Global Positioning System (GPS) receiver was installed in a NAL Do228

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Airplane as one of the navigation systems. A laser tracker was used as its reference, so GPS could be evaluated continually and accurately. This paper describes the results and influence of the geometric dilution of precision and of the receiver characteristic.

Author

A92-56120

MEASUREMENT OF POSITION AND ATTITUDE USING LASER AND RETRO-REFLECTORS

T. TSUMURA, T. OKUBA, N. KOMATSU, and M. NIWA IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 536-539. In Japanese. refs

This paper proposes a method for measuring the position and attitude of a vehicle by using a laser-scanner and retro-reflectors. Retro-reflectors are attached to the underside of the vehicle, and the orientation angle of the reflected beams is measured to calculate the position and attitude of the vehicle in three-dimensional space. This paper presents the theory of the measurement.

Author

N92-13048# National Aerospace Lab., Tokyo (Japan). Control Systems Div.

THE OBSERVATIONS AND ANALYSIS OF SELECTIVE AVAILABILITY IN GPS

MASAAKI MURATA and MASATOSHI HARIGAE (Toshiba Corp., Kawasaki, Japan) Apr. 1991 22 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1105) Avail: CASI HC A03/MF A01

Selective Availability (SA) of the Global Positioning System (GPS) was tested from March 25 to August 28, 1990. The objective of SA is to degrade the positioning accuracy of civilian GPS users by intentionally adding errors to the broadcast ephemerides and satellite clocks of the GPS navigation message. SA is expected to be fully implemented by about mid-1993. Presently, only Block II GPS satellites have full SA capability.

Author

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A92-15326

AIRCRAFT DESIGN EXPERIENCE

S. KIKUHARA (Japan Society for Aeronautical and Space Sciences, Journal, vol. 39, Aug. 1991, p. 379-387) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 87-98. Translation. Previously cited in issue 24, p. 4204, Accession no. A91-55451. Copyright

A92-15334

STRATOSPHERIC LIGHTER-THAN-AIR POWERED PLATFORM

M. ONDA (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 156-162. refs

Copyright

A feasibility study has been carried out on a high altitude (20 km) superpressured PLTA (powered lighter-than-air) platform, which has a long service life and larger payload than that of a large artificial satellite. This PLTA platform has an electric propulsion system to cope with wind flow for position keeping and its thruster is driven by solar power acquired through solar cells. Solar energy is to be stored for night use in regenerative fuel cells. The study is focused on energy balance and hull structure analysis of the platform. This platform is particularly capable of conducting high resolution remote sensing and telecommunications relay. This

platform can replace a number of ground-based telecommunications relay facilities and can guarantee reasonable radio frequency intensity enough to secure good telecommunications quality. The altitude where the platform resides is the least windy area in the lower stratosphere at a height from which one can have a direct line of sight on the ground within a 1,000 km diameter range. The platform can also be useful to chase typhoons and to observe them from their births in the tropical regions.

Author

A92-17876

CABIN STRUCTURAL VIBRATION AND NOISE FOR TRANSPORT AIRCRAFT

GENKICHI FUJIWARA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 497-503. In Japanese. refs

In this analysis of cabin structural vibration and noise of transport aircraft, evaluations of sound pressure level are addressed. Noise features such as engine vibration, multiple pure tone, and blade passing frequency are examined, and the vibration tolerance of human body is discussed.

Y.P.Q.

A92-25502

AN EXPERIMENT ON THE WEIGHT VS CONTROL RELATIONS OF SUBSONIC AIRPLANES

KENJI KARASAWA and KANICHIRO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 455, 1991, p. 651-661. In Japanese. refs

This paper discusses the effect of weight on control and gust responses. A fixed-base flight simulator is used to compare three aircrafts, a microlight airplane, P2V-7, and B-747. The microlight is shown to be difficult to fly in severe winds. Much difference is not seen between P2V-7 and B-747. These results agree with a simplified Bode analysis of the respective aircraft.

Author

A92-29518

A NOTE ON THRUST CONTROL FOR JETLINER DURING APPROACH

TSUNEHARU UEMURA and KANICHIRO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 457, 1992, p. 92-102. In Japanese.

A method of thrust control is shown for jetliner during approach. With this method, the pilot can reduce airspeed deviation even or less compared with the operation under auto throttle system. In this way, airspeed can be controlled with adequate thrust change, without extra acceleration or deceleration. The flight record is shown to substantiate this.

Author

A92-38206

THE QUIET STOL RESEARCH AIRCRAFT ASUKA

YOSHIO HAYASHI (National Aerospace Laboratory, Chofu, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 46-53. In Japanese.

The characteristics of the ASUKA research aircraft and its design are presented. The wind tunnel tests, flight simulations, and engine tests are described. The USB (upper surface blowing) powered high lift system, the stability and control system, and structures using heat-resistant composite material are discussed.

Y.P.Q.

A92-43118

OPTIMIZATION OF BLADE STRUCTURE TO REDUCE ROTOR VIBRATION

MASATO TOKI, K. NAGAI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and HIROSHI SUGIMOTO (Muroran Institute of Technology, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 120-123. In Japanese. refs

Helicopter blade structural optimization is presented. Rotor vibration is calculated taking aeroelasticity into account. The

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optimization flow chart is presented and the optimal distribution of blade spanwise location is discussed. Y.P.Q.

A92-43138 OPERATIONAL PROGRESS OF THE STOL RESEARCH AIRCRAFT ASUKA

MAKOTO SASAKI, SHIZUO SEKINE (National Aerospace Laboratory, Chofu, Japan), HIROKAZU MIYATAKE (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and H. MATSUOKA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 200-203. In Japanese. refs

The operational progress and FJR710/600S engine of the STOL research aircraft Asuka are presented. Flight tests of the STOL aircraft for engine operation including payload operation and engine overhaul are discussed. The improved design of the FJR710/600S engine is emphasized. Y.P.Q.

A92-43140 STOL RESEARCH AIRCRAFT ASUKA FLIGHT ANALYSIS IN CONNECTION WITH THE OPERATION OF THE MONITORING SYSTEM

K. YAZAWA and T. SHIMOMURA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 208-211. In Japanese. refs

The real-time monitor system for the flight test of the STOL research aircraft Asuka is presented. The data process analysis system for STOL is addressed. The operational process of the flight test center is illustrated. Y.P.Q.

A92-43142 FLIGHT TEST RESULTS AND UPPER SURFACE BLOWING (USB) TECHNOLOGY OF THE STOL RESEARCH AIRCRAFT ASUKA

TOSHIO BANDO, NORIAKI OKADA, SUKEYUKI TERUI (National Aerospace Laboratory, Chofu, Japan), H. OWA (Tokyo, University, Japan), MASAMICHI KURIYAMA, YOSHINARI TOBINAGA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) et al. IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 220-227. In Japanese.

The vertical aerodynamic characteristics of the STOL research aircraft Asuka have been evaluated. A comparison between flight test result and wind tunnel test results is presented. The effectiveness of boundary layer control is described. Y.P.Q.

A92-43143 FLIGHT TESTS ON THE STRUCTURES OF THE STOL RESEARCH AIRCRAFT ASUKA

MASAAKI SANO, MASATAKA HAKUI (National Aerospace Laboratory, Chofu, Japan), TOYO SHIMOMURA, and H. AONO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 228-231. In Japanese. refs

Data on the structural strength of the STOL research aircraft Asuka are presented. Data on the flight performance are analyzed. Measurements of flight payload, local stress, and vibration are presented. Y.P.Q.

A92-43149 THE LANDING EQUIPMENT OF A HIGH-TECH AIRCRAFT

TAKEO KIKUCHI (All Nippon Airways Co., Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 256-259. In Japanese.

The landing system for a large jet aircraft is presented. The thermal resistance of the brake is discussed, and the tire characteristics are examined. Y.P.Q.

A92-43189

THE RELATIONSHIP BETWEEN THE WEIGHT AND FLIGHT CHARACTERISTICS OF A TRANSONIC AIRCRAFT

KENJI KARASAWA and KANICHIRO KATO (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 420-423. In Japanese. refs

The blast wind response of a transonic aircraft is evaluated. The structures of the simulated flight equipment are discussed. The relation between the weight and flight characteristics is examined. Y.P.Q.

A92-43242

THE CONCEPT OF AN UNMANNED FLYING VEHICLE AT HIGH ALTITUDE

M. ONDA, YASUSHI MORIKAWA, and K. MATSUDA (Mechanical Engineering Laboratory, Tsukuba, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 632-635. In Japanese. refs

Characteristics of various kinds of air platforms are examined. The configurations and structure of the unmanned flying vehicle at high altitude are presented. Problems such as airframe structure, wind drag reduction, energy supply, and vehicle recovery are discussed. Y.P.Q.

A92-43243

REEVALUATION OF THE MOTION OF AN AIRSHIP

UYAKO NITTA and S. ANDO (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 636-639. In Japanese. refs

The aerodynamic characteristics and configurations of an airship are presented. Results are presented on the Skyship 500. Y.P.Q.

A92-43244

SMALL AND COST-EFFECTIVE AIRSHIP FOR TRANSPORTATION

S. ANDO (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 640-643. In Japanese. refs

Such characteristics as the number of ground support personnel, airport size, and advertising revenue are discussed for a small airship. A calculation method for direct operating cost (DOC) is discussed, and the configurations of various kinds of airships are discussed. Y.P.Q.

A92-45396

AN ACROBATIC AIRSHIP 'ACROSTAT'

MASAHICO ONDA and YASUSHI MORIKAWA (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 269-273. (SAE PAPER 911994) Copyright

A novel type of airship or a powered LTA aircraft is proposed which is designed with a rather conventionally shaped hull and with conventional thrusters and is not made as a control configured vehicle nor does it utilize any sophisticated control mechanism. None of the control surfaces are installed but couples of stabilizers equipped to the aft hull, and without any active control tricks the vehicle holds its stability and realizes enhanced maneuverability performances. This newly conceived type model is named Acrostat. This airship can ascend and descend vertically and can perform somersaults, spiral flights, and rotates around its CG as the center of the movement. The paper deals with the structural design concept of the model, design data, and the attitude control principle. Author

A92-45397

DUCTED FAN VTOL FOR WORKING PLATFORM

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

SHOHEI NIWA and MASAYUKI SUZUKI (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 275-285. refs
(Contract MOESC-62850016)
(SAE PAPER 911995) Copyright

An automatic flight control system is designed for research models of remotely piloted ducted fan VTOL. Special attention is given to the study of control problems which would arise when the VTOL is used as a high-position working platform. Among these problems are the application of two time scale control theory for the feedback control system design, and the application of Kalman filter theory to process sensor data. I.S.

A92-45410

AERODYNAMIC DEVELOPMENT OF BOUNDARY LAYER CONTROL SYSTEM FOR NAL QSTOL RESEARCH AIRCRAFT 'ASKA'

HIROTOSHI FUJIEDA, HITOSHI TAKAHASHI, YOSHIT MIYAMOTO (National Aerospace Laboratory, Chofu, Japan), JUNICHI MIYASHITA, KENJI SAKAI (Kawasaki Heavy Industries, Ltd., Kobe, Japan), and YOSHIO MORITA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 405-412. refs
(SAE PAPER 912010) Copyright

ASKA, developed by National Aerospace Laboratory, is a quiet short take-off and landing (QSTOL) research aircraft adopting upper surface blowing concept as a powered high lift system. To achieve sufficient STOL performance by augmenting stall angle of attack and roll control power, a blowing BLC technique was applied to the outboard leading edges and ailerons. To supply high pressure air to save the BLC piping space, a BLC system which was fit for using high-pressure air was developed. The BLC system, in which BLC air is discharged by a series of discrete jets from small drilled holes (0.8 to 3.0 mm in diameter) arranged in a row, is one of the unique features of the aircraft. In this paper, the summary of the aerodynamic development of the BLC system is presented except for the air piping system. Author

A92-45436

FEASIBILITY STUDY ON A MICROWAVE-POWERED UNMANNED AERIAL VEHICLE FOR THE COMMUNICATION RELAY UTILIZATION

KINGO TAKASAWA (National Aerospace Laboratory, Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 665-676. refs
(SAE PAPER 912052) Copyright

Some component tests and a system definition study have verified the feasibility of microwave powered UAVs for communication relay utilization. The best choice of a power system composition is proposed with emphasis placed on the overall efficiency in cruise phase and adaptability in the climb phase. The integration into the ATC system, towed climb, monitored descent and emergency operations are described. R.E.P.

A92-45437

STRUCTURAL CONCEPT OF MAIN WINGS OF HIGH ALTITUDE UNMANNED AERIAL VEHICLE AND BASIC PROPERTIES OF THERMOPLASTIC COMPOSITES AS CANDIDATE MATERIAL

TAKASHI ISHIKAWA, YOICHI HAYASHI, MASAMICHI MATSUSHIMA (National Aerospace Laboratory, Tokyo, Japan), TATSUO SATO (Fuji Heavy Industries, Ltd., Tochigi, Japan), and KINGO TAKASAWA (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive

Engineers, Inc., 1991, p. 677-686. refs
(SAE PAPER 912053) Copyright

A conceptual design of an unmanned aerial vehicle operated at an altitude of 20 km and powered by microwave was developed using CAD software. Possible applications of this aircraft would be a platform for telecommunication relay or an earth observation base. It is found that an all-up mass of 400 kg would provide an optimal payload of 50 kg under certain input power conditions, and that an extreme weight reduction, such as a 93-kg main wing of 30-m span, would be required. A fundamental structural concept of this aircraft, particularly the main wing, is defined. Maneuvering envelopes are discussed and basic flight loads are determined. The spanwise thickness distribution of the tubular spar is calculated, and bending and torsional deflections are estimated. Static and fatigue tensile tests are conducted at an ambient temperature and a low temperature of -60 C for CF/PEEK specimens. C.A.B.

A92-45438

HIGH-ALTITUDE LIGHTER-THAN-AIR POWERED PLATFORM

MASAHIKO ONDA and YASUSHI MORIKAWA (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 687-694. refs
(SAE PAPER 912054) Copyright

To tackle global environmental problems, the acquisition of plentiful and precise data is necessary, and a means of conducting long-lasting high-resolution measurements over broad areas is required. A feasibility study has been made on a high-altitude (about 20 km), superpressured, helium-filled powered lighter-than-air (PLTA) vehicle as an ideal platform for environmental observation. It has a long service life and carries a larger payload than an artificial satellite. This PLTA platform, named HALROP (High Altitude Long Range Observational Platform), uses a solar-powered electric propulsion system to maintain its position in space against wind currents. The solar power is acquired from solar cells. For night use, solar energy is stored in regenerative fuel cells. This study examines energy balance and provides a structural analysis of the vehicle. Author

A92-45439

EXPERIMENTAL AND NUMERICAL STUDY OF AERODYNAMIC CHARACTERISTICS FOR SECOND GENERATION SST

KENJI YOSHIDA and KENJI HAYAMA (Kawasaki Heavy Industries, Ltd., Kamagihara, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 695-707. Research supported by Kawasaki Heavy Industries, Ltd. refs
(SAE PAPER 912056) Copyright

Attention is given to the effects of three typical drag reduction technologies, namely, the application of a suitable wing planform, a warped wing, and an area-ruled body by employing both experimental and numerical approaches. The increment of the cruise L/D is about 0.1 for an arrow planform, 0.6 for a warped wing, and 0.5 for an area-ruled body. It is inferred that the present SST configuration has an L/D of about 8.6 at cruise Mach number 2.0, including some corrections on the Reynolds number, fuselage volume, etc. Applying the present Navier-Stokes calculation code for these test models, it is found that the CFD code is very useful in predicting the characteristics of design conditions. C.A.B.

A92-46921

PREDICTION OF DYNAMIC HUB LOAD OF A ROTOR EXECUTING MULTIPLE SINUSOIDAL BLADE PITCH VARIATIONS

GIZO HASEGAWA, TOMOARI NAGASHIMA, and TOSHIFUMI NEKOHASHI (National Defense Academy, Yokosuka, Japan) IN: AHS International Specialists' Meeting on Rotorcraft Basic Research, Atlanta, GA, Mar. 25-27, 1991, Proceedings. Alexandria, VA, American Helicopter Society, 1991, p. 3-1 to 3-15. refs

Analytical and experimental studies were carried out for dynamic hub vertical load responses of a hingeless rotor in forward flight

due to simultaneous implementation of multiple sinusoidal blade pitch variations. The unsteady air loads were evaluated by the hybrid wake model to stress a near shed wake effects. By applying the generalized harmonic balance method to a linear, model equation of motion of the blade, elastic blade motions and associated unsteady air load distributions were determined iteratively and time histories of hub vertical load responses were expressed by the Fourier series in terms of the reduced blade azimuth angle. Effects of control input parameters on the dynamic hub vertical load responses were numerically examined at various advance ratios and the optimum combinations of control input parameters which could minimize the dynamic hub vertical loads were ascertained. Author

A92-53007

ESTIMATION OF AERODYNAMIC CHARACTERISTICS FROM FLIGHT-TEST DATA. I - MULTICOLLINEARITY IN THE EQUATION ERROR METHOD

OSAMU KOBAYASHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 463, 1992, p. 443-452. In Japanese. refs

The multicollinearity problem in the equation error method is discussed. This problem occurs not only when strong correlations between the explanatory variables are generated by the aircraft's maneuver, but also when the number of explanatory variables is greater than the maximum number of variables which can be essentially independent in the equation of motion. The physical meaning of the partial regression coefficients and the multicollinearity is explained. L.M.

A92-53671

A DEVELOPMENT OF A HEAVY LOAD BALLOON MADE OF FIBER REINFORCED FILM

NAOYUKI WATANABE, MASAMI FUJII, RYOJIRO AKIBA, MOTOKI HINADA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and TADASHI TAGA (Taiyo Kogyo Corp., Research and Development Dept., Osaka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1583-1588. refs

Copyright

Japan's Institute of Space and Astronautical Science has undertaken the development of a heavy-payload balloon envelope material whose polymeric film is reinforced by a fine fabric; the resulting composite resists ground-handling damage more readily than conventional thin films. Results are presented from the various qualifications tests that have thus far been conducted with a scale model; these encompass tearing strength at room and stratospheric temperatures, crack-bearing membrane tensile strength, jointed-zone tensile strength, and He gas permeability. O.C.

A92-56014

FLUTTER ANALYSIS AND WIND TUNNEL TEST WITH RESPECT TO A LOW-ASPECT-RATIO WING WITH FREE-ROTATIONAL CONTROL SURFACE

N. TODA, H. TANEDA, and M. NAGAHATA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 56-59. In Japanese.

It is well known that the rotational mode of control surface with no balance-weight couples with wing vibrational mode, and causes control surface-wing flutter. Analytical result of our low-aspect-ratio wing with free-rotational surface shows two unstable regions, and each region corresponds to different flutter modes. A wind tunnel test has been conducted using a new test procedure, and the above phenomenon analytically predicted has proven to exist. Author

A92-56015

AN EXAMPLE OF WHIRL FLUTTER ANALYSIS

TOMIO SANDA and HIROFUMI SASHIKUMA (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th,

Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 60-63. In Japanese. refs

The whirl flutter analysis of a research aircraft model is presented. The damping characteristics are considered for turboprop engines are discussed. The modal damping coefficient of the entire aircraft and flutter rate are analyzed. Y.P.Q.

A92-56016

PROPELLER-NACELLE WHIRL FLUTTER ANALYSIS AND WIND TUNNEL TEST

NOBUO TODA, MASASHI NAGAHATA, NAOKO KAWAMURA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), SHIGERU SATO, and YUTAKA IWAHORI (NIPPI, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 64-67. In Japanese. refs

A newly developed method of estimating the whirl flutter characteristics of propeller-nacelle system was presented. A flutter wind tunnel test was also conducted using the powered 2 DOF model, and test data was compared with the analytical results. All analytical results were slightly conservative compared with the experimental data. This method has proven to be useful to estimate the whirl flutter characteristics. Author

A92-56017

WHIRL FLUTTER ANALYSIS AND APPLICATION TO AIRCRAFT DESIGN

M. NAGAHATA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 68-71. In Japanese.

An investigation with respect to the estimation of whirl flutter characteristics was presented using a 2 DOF analytical model. Two cases studies about structure design of nacelle system were conducted, and following guidelines were proposed. A pusher type prop.-nacelle system with high structural damping will have better whirl flutter characteristics compared with a tractor type. A nacelle design having much difference between pitch and yaw inertia will be very effective to reduce the coupling of pitch-yaw motions. Author

A92-56018

OPTIMIZATION OF COMPOSITE MATERIAL WING OF FIGHTER TYPE AIRCRAFTS

T. ONISHI and S. TAURA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 72-75. In Japanese. refs

Composite materials have been widely used as major components of aircraft structure. Aeroelastic tailoring is one of the design techniques that would minimize weight of the structure satisfying aeroelastic requirements such as flutter speed or buckling strength etc., by controlling stiffness of the structure. MHI have been studying this area and developed aeroelastic tailoring tool called 'Miracle'. Optimizing logics adopted in Miracle and an optimization instance are shown in this paper. Author

A92-56019

RESEARCH ON AEROELASTIC TAILORING AT NAL

KOJI ISOGAI, IKUO KUMAKURA, and JIRO NAKAMICHI (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 76-79. In Japanese. refs

The research on aeroelastic tailoring at NAL is presented. Aft swept wing wind tunnel models and a full scale forward swept wing are designed using the optimization program based upon a sequential complex method, in which the derivatives of objective/constraint functions are not needed. A way of making scale models for flutter tests is also presented. The effects of the optimized fiber orientation on the flutter characteristics of forward/aft swept wing models with a core composite plate are

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examined experimentally. Our theoretical and experimental investigations revealed that AET can greatly improve the aerolastic characteristics of the forward/aft swept wings in the transonic range. Author

A92-56020

ANALYSIS AND WIND TUNNEL TEST OF LOW ASPECT WING GUST LOAD ALLEVIATION

YUJIRO SHIRAI, MASASHI NAGAHITA, HIROYUKI TANAKA, and AKITO TAKAGI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 80-83. In Japanese. refs

An aeroelastic model of aircraft wings is presented. The linear quadratic Gaussian method is presented, and wing gust load alleviation control design is discussed. A comparative analysis of the effectiveness of wing gust load alleviation is presented. Y.P.Q.

A92-56051

ANALYSIS OF THE MAIN WING LIFT DISTRIBUTION OF THE STOL RESEARCH AIRCRAFT ASUKA

K. YAZAWA, H. INOKUCHI (National Aerospace Laboratory, Chofu, Japan), H. WAKAHARA et al. IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 230-233. In Japanese. refs

The airfoil and upper surface blowing (USB) flap tests of the STOL research aircraft Asuka are presented. The airfoil pressure distribution was measured. The panel method is used for the numerical calculation of the lift distribution. Y.P.Q.

A92-56061

A NOTE ON THRUST CONTROL FOR JETLINER DURING APPROACH

TSUNEHARU UEMURA (Japan Airlines Co., Ltd., Tokyo) and KANICHIRO KATO (Tokyo, University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 270-273. In Japanese.

A method of thrust control is shown for jetliner during approach. With this method, the pilot can reduce airspeed deviation even or less compared with the operation under the auto throttle system. In this way, airspeed can be controlled with adequate thrust change, without extra acceleration or deceleration. A flight record is shown to substantiate this. Author

A92-56072

EFFICIENCY AND ACCURACY IN HELICOPTER HOVERING PERFORMANCE CALCULATION

TATSUYA MASUE (Kumamoto Institute of Technology, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 314-317. In Japanese.

The blade sectioning method is used for the calculation of helicopter hovering performance. The rotor thrust coefficient and torque shape coefficient are addressed. Flight test results are given and blade wind test data are presented. Y.P.Q.

A92-56073

SENSITIVITY ANALYSIS FOR STRUCTURAL OPTIMIZATION OF HELICOPTER ROTOR BLADES

MASATO TAKI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) and HIROYUKI SUGIMOTO (Muroran Institute of Technology, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 318-321. In Japanese. refs

The optimal design of helicopter rotor blades using sensitivity analysis is presented. The character of natural vibration variations is discussed. Y.P.Q.

A92-56075

DESIGN AND TESTING OF A COMPOSITE HINGELESS HUB FOR ROTARY-WING AIRCRAFT

KEIZOU YAMAMOTO, TAKAHIRO ICHIHASHI (Japan Defense Agency, Technical Research and Development Institute, Tokyo), SHUNICHI BANDO, and ASAO KAKINUMA (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 326-329. In Japanese.

The structures of a composite hingeless hub for rotary-wing aircraft is presented. Strength and rigidity tests for the design of the hingeless hub are described, and tower rotation test results are analyzed. The cyclic regressive mode is discussed. Y.P.Q.

A92-56077

PILOTED SIMULATION FOR THE BK117 FBW DEMONSTRATOR

SHOJI TANASE (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 334-337. In Japanese.

The flight control system design of a research helicopter is presented. The piloted simulation test is introduced, and flight control modes such as attitude command attitude hold (ACAH) and rate command attitude hold (RCAH) are addressed. The flight control computer system is described. Y.P.Q.

A92-56112

OPTIMAL DESIGN OF WING SHAPE BY USE OF NEURAL-NETWORK

WASASHI HARADA, TAKEHISA KOHDA, and KOICHI INOUE (Kyoto University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 502-505. In Japanese. refs

It is shown that (1) the induced drag of a wing can be expressed in a tensor form by using the vortex-lattice method, (2) the above induced drag can be easily minimized by applying neural-network computing techniques, and (3) the resultant minimum-drag wing shape is similar to the crescent wing. Author

A92-56115

FLIGHT SIMULATOR TEST OF COCKPIT ADVISORY SYSTEM

KEIJI TANAKA, HIROYASU KAWAHARA, MASAHIKO NAGAYASU, KOHTARO MATSUMOTO (National Aerospace Laboratory, Chofu, Japan), ATSUSHI WATANABE, AKIHIRO ITO, and HIDEO MASUZAWA (Fujitsu, Ltd., Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 516-519. In Japanese.

This paper describes flight simulation of a cockpit human interface that timely displays aircraft conditions, warnings, and suggestions of initial actions, as well as operational procedures by monitoring aircraft utility systems. The system, called Cockpit Advisory System, is an intelligent display which behaves as a live flight manual. The current system was developed by using the utility systems of ASKA, an STOL experimental aircraft of the National Aerospace Laboratory. The system has two display units controlled by a real-time expert system. The flight simulator tests revealed that the system (1) reduced pilot workload remarkably, (2) enhanced crew coordination and situation awareness, and (3) created a completely different cockpit environment. Author

N92-13930* Tokyo Univ., Sagami-hara (Japan). Inst. of Space and Astronautical Science.

AERODYNAMIC AIRCRAFT DESIGN METHODS AND THEIR NOTABLE APPLICATIONS: SURVEY OF THE ACTIVITY IN JAPAN

KOZO FUJII and SUSUMU TAKANASHI (National Aerospace Lab., Tokyo, Japan) IN: Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) p 31-44 1991

Avail: CASI HC A03/MF A06

An overview of aerodynamic aircraft design methods and their recent applications in Japan is presented. A design code which

was developed at the National Aerospace Laboratory (NAL) and is in use now is discussed, hence, most of the examples are the result of the collaborative work between heavy industry and the National Aerospace Laboratory. A wide variety of applications in transonic to supersonic flow regimes are presented. Although design of aircraft elements for external flows are the main focus, some of the internal flow applications are also presented. Recent applications of the design code, using the Navier Stokes and Euler equations in the analysis mode, include the design of HOPE (a space vehicle) and Upper Surface Blowing (USB) aircraft configurations. Author

N92-18482# National Aerospace Lab., Tokyo (Japan). Flight Research Div.

A PRELIMINARY FLIGHT TEST ON A BASIC PERFORMANCE OF THE FLIGHT RESEARCH AIRPLANE DO 228: VELOCITY VS GLIDE PATH ANGLE

YOSHIKAZU MIYAZAWA (Tokyo Denki Univ. (Japan).), TAKATSUGU ONO (Tokyo Denki Univ. (Japan).), and YASUHIRO KAWAGOE (Tokyo Denki Univ., Japan) Oct. 1989 18 p (ISSN 0452-2982)

(NAL-TM-613; JTN-92-80249) Avail: CASI HC A03/MF A01

A preliminary flight test was conducted on the research airplane Dornier Do228-200 that is being modified for use as an in-flight simulator by the National Aerospace Lab (NAL). The basic performance of the aircraft was evaluated by the flight test. Glide path angles were examined with various parameters such as velocity, altitude, and power. The flight test results were compared with those of a mathematical model based on the Dornier GmbH wind tunnel test data. Since an onboard data acquisition system is under development and only primitive measurement is available, accuracy of the flight test is limited. This flight test, however, has verified the mathematical model to some extent, and has given useful data for future flight tests. Author (NASDA)

N92-27429# National Aerospace Lab., Tokyo (Japan). Flight Research Div.

NAL DORNIER 228-200 FLIGHT RESEARCH AIRPLANE: PRESENT STATUS AND OUTLINE OF THE INSTALLED EQUIPMENT

TAKATSUGU ONO Jul. 1991 56 p In JAPANESE; ENGLISH summary Original contains color illustrations (ISSN 0452-2982)

(NAL-TM-637; JTN-92-80375) Avail: CASI HC A04/MF A01

An outline is presented concerning the present status of the Dornier 228-200, a NAL flight research airplane introduced in 1988. A description is given of the plane's introduction process, modifications, currently installed equipment and ground support system, and typical flight data. Technical information is provided which will be useful for planning various kinds of future flight experiments. Author (NASDA)

N92-28153# National Aerospace Lab., Tokyo (Japan). Flight Test Team.

EVALUATION OF HIGH LIFT DEVICES OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA

TOSHIO BANDO Apr. 1991 33 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1102; JTN-92-80379) Avail: CASI HC A03/MF A01

The powered high lift device of the ASKA, the NAL Short Take Off and Landing (STOL) experimental aircraft, is an Upper Surface Blowing (USB) device that forces the jet exhaust flow downward, thus producing higher lift due to the Coanda effect. Three pieces of equipment were incorporated that enhanced the USB high lift generation: Boundary Layer Control (BLC), drooped ailerons, and vortex generators. The aerodynamic effects of these equipment are described based on flight test data. In early flight test stages, a shallow ASKA USB flap configuration encountered buffeting, beginning at a lower angle of attack than expected, thereby limiting the flight envelope. Based on the wind tunnel test surveys, a nacelle fence and drooped leading edge were

subsequently installed to delay the buffet onset. The effect of these devices is also discussed based on flight test results.

Author (NASDA)

N92-28191# National Aerospace Lab., Tokyo (Japan). Flight Test Team.

EVALUATION OF LANDING CONFIGURATION BY FLIGHT TEST OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA
TOSHIO BANDO May 1991 58 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1113; JTN-92-80382) Avail: CASI HC A04/MF A01

During the design phase of NAL Short Take Off and Landing (STOL) experimental aircraft, ASKA, the landing configuration was determined to be a 40 degree Upper Surface Blowing (USB) flap angle and a 65 degree outboard flap angle, whereas the design phase go around configuration was specified as a 20 degree USB flap angle, a 65 degree outboard flap angle, and leading edge Boundary Layer Control (BLC) off. Based on the results of alpha sweep tests and landing evaluations, it was determined that the design landing configuration had a small alpha-margin and high pitch attitude which produced poor downward viewing during approach and landing. The alpha-margin of the design go around configuration was also respectively small. Subsequently, flight tests were conducted to determine new configurations for landing and go around, and using these test results, a 60 degree USB flap angle was selected for the landing configuration and a 30 degree USB flap angle was for the go around one. A 65 degree outboard flap angle with all BLC on was also decided for both configurations. The process of determining these final configurations using flight tests and evaluations is discussed. Author (NASDA)

N92-28901# National Aerospace Lab., Tokyo (Japan). Flight Test Team.

AERODYNAMIC CHARACTERISTICS OBTAINED FROM ALPHA SWEEP TEST OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA

TOSHIO BANDO May 1991 67 p In JAPANESE (ISSN 0389-4010)

(NAL-TR-1112; JTN-92-80381) Avail: CASI HC A04/MF A01

Longitudinal aerodynamic characteristics are one of the most important considerations in aircraft design. Using the NAL Short Take Off and Landing (STOL) experimental aircraft, ASKA, an alpha sweep method was adopted instead of using the conventional discrete method to investigate ASKA's longitudinal aerodynamic characteristics. ASKA's longitudinal aerodynamic characteristics are described based on analysis of the test results. In addition, longitudinal aerodynamic coefficients obtained from flight tests are compared with the ASKA's wind tunnel design configuration. ASKA showed a pitch up phenomena during shallow Upper Surface Blowing (USB) flap angles, and also encountered path divergence in the flaps up configuration, being a significant phenomena for a powered lift aircraft. Powered lift aircraft's lift coefficient consists of basic lift due to wing and flaps; direct jet thrust, and supercirculation. This lift build-up is described using calculation results of flight test data. The powered lift factor, a key parameter for powered lift aircraft, is also described. Author (NASDA)

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A92-40262

BIAS OF AN OPTICAL PASSIVE RING-RESONATOR GYRO CAUSED BY THE MISALIGNMENT OF THE POLARIZATION AXIS IN THE POLARIZATION-MAINTAINING FIBER RESONATOR

KOICHI TAKIGUCHI and KAZUO HOTATE (Tokyo, University,

06 AIRCRAFT INSTRUMENTATION

Japan) Journal of Lightwave Technology (ISSN 0733-8724), vol. 10, no. 4, April 1992, p. 514-522. refs
Copyright

An analysis is conducted of the optical passive ring-resonator gyro bias generated by the misalignment of the polarization axis, in the resonator that is formed by the polarization-maintaining fiber. This bias can be suppressed by setting the fiber polarizers at the lead portions of the resonator. It is also established that polarizer parameter requirements are severe, when their goal is high-performance aircraft navigation. O.C.

A92-43139

OPERATION OF THE ON-BOARD MEASURING SYSTEM OF THE STOL RESEARCH AIRCRAFT ASUKA

T. OKA, YOSHIO SAKURAI (National Aerospace Laboratory, Chofu, Japan), T. YUTO, and H. OKADA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 204-207. In Japanese. refs

The structure of the measuring sensor and the on-board measuring system for the Asuka aircraft are described. Fault control and maintenance procedures are reported. Y.P.Q.

A92-43150

INTRODUCTION TO THE TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) III

M. SHIRAKAWA, K. OSE, and TOYO FUKUDA (Ministry of Transport, Electronic Navigation Research Institute, Mitaka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 260-263. In Japanese. refs

The signal system, azimuth derivation accuracy, and azimuth error monitoring of the traffic alert and collision avoidance system (TCAS) III is introduced. The collision avoidance algorithm and avoidance modeling are discussed. Y.P.Q.

A92-43151

THE TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) FOR AIR NAVIGATION

YUKIO OYANAGI (All Nippon Airways Co., Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 264-267. In Japanese.

Features of the traffic alert and collision avoidance system (TCAS) are presented. The improvement plan for the TCAS is given and the TCAS data acquisition system and crewmember training are described. Y.P.Q.

A92-43208

DEVELOPMENT OF THE D-SIZE LIQUID CRYSTAL FLAT PANEL DISPLAY FOR AIRCRAFT

TATSUO SHIMIZU, KENJI MATSUMURA, and O. OYAMA (Japan Aviation Electronics Industry, Ltd., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 496-499. In Japanese. refs

The functions and performance of the D-size liquid crystal flat panel display (FPD) are presented. The brightness distribution of the pixel pattern of a high-resolution CRT discussed. Evaluations using the primary flight display and the digital map display are described. Y.P.Q.

A92-43209

EVALUATION TEST ON THE SIMULATOR OF THE LIQUID CRYSTAL FLAT DISPLAY. II

HIROYASU KAWAHARA, AKIRA WATANABE, KAORU WAKAIRO (National Aerospace Laboratory, Chofu, Japan), TATSUO SHIMIZU, KENJI MATSUMURA, and O. OYAMA (Japan Aviation Electronics Industry, Ltd., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 500-503. In Japanese. refs

The characteristics and performance of the liquid crystal display (LCD) panel are presented. The flight simulation test signal system

and primary flight display (PFD) and map display system are illustrated. The flight simulator motion model is discussed.

Y.P.Q.

A92-43217

DISPLAY TRENDS IN AIRCRAFT COCKPITS

M. SHIBATA (Japan Defense Agency, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 532-535. In Japanese.

The cockpit display and man-machine interface of aircraft are presented. The performances of various display devices are analyzed, such as the flat panel display (FPD), the liquid crystal display (LCD), HUD, and CRT. Projected future cockpit systems are also considered. Y.P.Q.

A92-43220

RESEARCH ON A HELICOPTER INFORMATION CONTROL SYSTEM

SHUICHI YOKOKURA (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 544-547. In Japanese. refs

An analytical method for a helicopter information control system is presented. The structure of the system is illustrated, and model-evaluation results of the system are described. Y.P.Q.

A92-43221

ADVANCED DISPLAY SYSTEM FOR AN AIRCRAFT PAYLOAD

TOSHIJI OHASHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 548-551. In Japanese. refs

A man-machine interface system for aircraft control is presented. The effectiveness of the advanced display system is described and the flat panel display (FPD) and HUD system are addressed. A comparison between liquid crystal display (LCD) and CRT is made. Y.P.Q.

A92-43222

CURRENT STATUS AND FUTURE TASKS OF A COCKPIT LIQUID CRYSTAL DISPLAY

RYOJI YAMADA (Japan Aviation Electronics Industry, Ltd., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 552-555. In Japanese. refs

The development of a cockpit LCD is discussed. The display qualities of the LCD are examined, considering the characteristics of the man-machine interface. Computer processing is applied to achieve the required brightness and color of the LCD. Y.P.Q.

A92-43224

DEMONSTRATION PERFORMANCE OF AN AIRCRAFT LIQUID CRYSTAL DISPLAY

K. IKEDA, E. AWAMURA, and S. YAMAMOTO (Tokyo Aircraft Instrument Co., Ltd., Komae, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 560-563. In Japanese. refs

The performance of an on-board liquid crystal display (LCD) is discussed. The LCD is compared with the CRT in terms of brightness, color, contrast, and visual field is discussed. The brightness distribution is examined. Y.P.Q.

A92-43225

DIGITAL MAPPING DISPLAY TECHNOLOGY

ICHIZO KOBAYASHI (Toshiba Corp., Kawasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 564-567. In Japanese.

An aircraft digital mapping display system (DMS) is discussed, with particular attention given to the man-machine interface. The characteristics of the DMS are described, and the topographic display method is discussed. Y.P.Q.

A92-45449

A SIMULATOR STUDY OF A FLIGHT REFERENCE DISPLAY FOR POWERED-LIFT STOL AIRCRAFT

KEIJI TANAKA, HIROYASU KAWAHARA, MASARU NAKAMURA, and YUSHI TERUI (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 805-814. refs
(SAE PAPER 912067) Copyright

The display design was aimed at providing pilots with new control cues for keeping its flight safety in low-speed and high-power approach. The display utilizes the angle of attack, pitch angle, and airspeed to indicate the flight reference for maintaining the flight safety margins. The display integrates the flight reference into an analogue airspeed scale. Results of the piloted simulation confirmed that performance of the display was satisfactory for both flight reference tracking and safety margin monitoring, and proper values of coefficients of the display equations were obtained. Author

A92-56059

FLIGHT TEST OF A FLIGHT REFERENCE DISPLAY FOR POWERED-LIFT STOL AIRCRAFT

KEIJI TANAKA, HIROYASU KAWAHARA, MASARU NAKAMURA, YUSHI TERUI, TOSHIHARU INAGAKI, KOHEI FUNABIKI, YUKICHI TSUKANO, and TAKATSUGU ONO (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 262-265. In Japanese. refs

A flight reference display which indicates the safety margin of powered-lift STOL aircraft was evaluated in flight tests by using the in-flight simulator, the Variable Stability and Response Airplane (VSRA). This paper outlines the flight tests. Objectives of these flight tests were to determine the best combination of pitch attitude and angle of attack in the flight reference equation and to evaluate general availability of a flight reference display system. For these flight tests, the flight reference display system, which consists of flat-panel liquid-crystal display panel and the interface computer, was developed and installed in VSRA. The flight test results to date reveal that the larger contribution of the angle of attack was acceptable, and that employing the limitation due to horizontal gust margin in the display algorithm effected better handling qualities as well as other information for further improvements of the flight reference display. Author

A92-56063

THE EFFECT OF CLUTTER ON MISSILES AT A LOW ALTITUDE

TAKESHI KURODA and FUMIAKI IMADO (Mitsubishi Electric Corp., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 278-281. In Japanese. refs

Clutter spectra in an airborne radar of a missile at a low altitude are calculated for several situations, and the effects of the missile altitude on clutter spectra are discussed. The results show that most of the clutter power distributed over all Doppler frequency, except for the return of the main lobe, consists of the reflected power from the sea surface right under the missile. When the off-boresight tracking is applied to the above geometries, the clutter power decreases about 11 dBm on the main lobe frequency, and about 3 dBm on other frequencies, while the signal power from the target decreases 4 dBm. Author

A92-56082

ENGINE CONDITION MONITORING SYSTEM FOR B747-400

TOSHIHIKO NOGUCHI (All Nippon Airways, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 366-369. In Japanese.

A new engine condition monitoring system is introduced, which has the automatic data acquisition system using the Aircraft

Condition Monitoring System and Aircraft Communication Addressing and Reporting System. A ground-based engine-monitoring system is also introduced as the main part of the system. In the flight data monitoring, it was shown that the deviation from the predicted value of the standard engine model is not the best parameter for detecting the sudden shift of the gas-path parameter due to internal engine damage, using the data acquired from a flight. Author

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

A92-14709

TEST RESULTS OF THE EXPANDER CYCLE AIR TURBO RAMJET FOR A FUTURE SPACE PLANE

NOBUHIRO TANATSUGU, YOSHIHIRO NARUO (Institute of Space and Astronautical Science, Sagami, Japan), ITARU ROKUTANDA, TOMOAKI MIZUTANI, KAZUYUKI HIGASHINO, MASATO OGUMA, and SYOICHI OBATA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs

(IAF PAPER 91-271) Copyright

ISAS has been engaged in development study on the air-turbo ramjet (ATR) propulsion system to be applied for a future space plane. The ATR engine is a combined-cycle air-breathing propulsion system consisting of a turbojet and a ramjet, using liquid hydrogen as fuel. This engine system was named Atrex because it employs an expander cycle. The feasibility of Atrex is being assessed by sea-level static tests using the 1/4-scale model (Atrex-500) with fan inlet diameter of 300 mm and overall length of 2000 mm. Author

A92-17503

NUMERICAL SIMULATION FOR VARIOUS FLOWFIELDS OF AERO-ENGINE COMPONENTS

KOJI MATSUNAGA, YASUNORI ANDO, ATSUSHIGE TANAKA, and HIDEKI TOH (Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 31, July 1991, p. 230-237. In Japanese. refs

Advances in aero-engine performance and economy are achieved by a fusion of many individual efforts in technology. Significant advances in the evolution and rationalization of aerodynamic technology appear in the development and utilization of CFD. CFD demonstrates valuable applications and is an essential complement to testing and experimentation. A brief review is presented of the current status and the future of CFD on the aero-engine development including: (1) 3D compressible Navier-Stokes computation for turbine-vane configurations; (2) incompressible Navier-Stokes computation for gas turbine combustor; and (3) Euler and Navier-Stokes computations for some ducts, stator/downstream strut interaction and swan-neck duct. Author

A92-17849#

SCRAMJET RESEARCH AT THE NATIONAL AEROSPACE LABORATORY

HIROSHI MIYAJIMA (National Aerospace Laboratory, Kakuda Research Center, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 10 p. refs
(AIAA PAPER 91-5076) Copyright

A review of research conducted on scramjet engines at the National Aerospace Laboratory of Japan is presented. An initial configuration was adopted similar to that of the NASA Langley fixed-geometry, airframe-integrated modular scramjet. Results of

07 AIRCRAFT PROPULSION AND POWER

component tests and numerical simulations, subscale engine design and fabrication, and special features of the ramjet test facility currently under construction are discussed. R.E.P.

A92-35911

TECHNICAL HISTORY OF AIRCRAFT ENGINES

KEIZO HATTA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 188-191. In Japanese.

The historical development of Japanese aircraft and spacecraft engines is presented. Research on short takeoff and landing (STOL) aircraft and H-I and H-II rockets is emphasized. Possible future trends in the development of aircraft engines are outlined.

Y.P.Q.

A92-35912

RESEARCH ON AIRCRAFT ENGINES

TAKURO OKAZAKI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 192-194. In Japanese.

The development of Japanese aircraft engines is reviewed. The computer-aided fluid mechanical design for gas turbine engines is addressed. Aerodynamic noise and structural analysis are considered.

Y.P.Q.

A92-35914

TRENDS OF RESEARCH ON CASCADE FLUTTER

HIDEO TANAKA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 201-208. In Japanese. refs

A numerical analysis of cascade flutter and its characteristics is presented. The effectiveness of three-dimensional cascade flutter is described. The computation of both steady and unsteady transonic flows in cascade flutter is examined.

Y.P.Q.

A92-35915

COMBUSTION RESEARCH AND DESIGN TECHNOLOGY OF AIRCRAFT ENGINES

TAKASHI TAMARU Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 209-213. In Japanese. refs

Computational fluid technology is used for the combustor design of aircraft engines. The fuel vaporizer for a gas turbine engine is analyzed and Knight and Walker methods are used for the component pressure losses in combustion chambers.

Y.P.Q.

A92-35917

AN AIRCRAFT CONTROLLER AND ITS DEVELOPMENT

HIDEKATSU KIKUCHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 220-224. In Japanese. refs

The characteristics of aircraft engine control is discussed. The hydromechanical control (HMC) and full authority digital electronic control (FADEC) systems are compared. Future trends in the area of engine control systems are discussed.

Y.P.Q.

A92-35919

DEVELOPMENT TRENDS OF RECENT AIRCRAFT ENGINES

SOTOSHI YASHIMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 229-234. In Japanese. refs

Development trends of commercial and military aircraft engines are presented. The outlet temperature of engine combustors is calculated, and engine propulsion and combustion nozzles are addressed.

Y.P.Q.

A92-35921

PERSPECTIVE ON FUTURE AIRCRAFT ENGINES

SHOJIRO KAJI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 239-248. In Japanese. refs

The flight performance of double and single bypass engines is presented. The characteristics of the supersonic throughflow fan

is analyzed. Scramjet engines and ram rockets are discussed.

Y.P.Q.

A92-36358

AEROELASTIC TAILORING ANALYSIS FOR ADVANCED TURBO PROPELLERS WITH COMPOSITE BLADES

TAKASHI YAMANE (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 235-245. refs

Copyright

The development of unsteady aerodynamic analysis with computational fluid dynamics important for investigating the aeroelastic characteristics of rotors made of advanced composite materials. The purpose of the present analysis is to establish an aeroelastic model useful for the preliminary design of advanced turbo propellers. An unsteady aerodynamic model of high subsonic cascade airfoils, including sweep effects and finite span effects, is combined with a structural dynamic model for composite pretwisted propeller blades to produce an aeroelastic analysis tool. The p-k modal flutter analyses for the SR-3 propeller model (made of graphite/epoxy) were conducted. They revealed that suitable combinations of the fiber orientation can eliminate flutter without any weight penalties or strength penalties and that the flutter velocity is found to be sensitive to the interblade phase angle as well as the fiber orientation. These results indicate the effectiveness of aeroelastic tailoring for advanced turbo propellers and also the usefulness of the present analysis.

Author

A92-36888

ANALYTICAL CONDITION INSPECTION AND EXTENSION OF TIME BETWEEN OVERHAUL OF F3-30 ENGINE

M. NAKAO (Japan Defense Agency, Tokyo), M. IKEYAMA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tanashi, Japan), and S. ABE (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 196-200. refs

(ASME PAPER 91-GT-277) Copyright

F3-30 is the low-bypass-ratio turbofan engine developed to power the T-4 intermediate trainer. The program to extend time between overhaul (TBO) of the F3-30 has been running. Analytical condition inspection (ACI) and accelerated mission testing (AMT) were conducted to confirm sufficient durability to extend TBO. Most deteriorations of parts and performance due to AMT were also found by ACI after field operation with approximately the same deterioration rate. On the other hand, some deteriorations were found by ACI only. These results show that ACI after field operation is also necessary to confirm the TBO extension, although AMT simulates the deterioration in field operations very well. The deteriorations that would be caused by the field operation during one extended-TBO were estimated with the results of ACI and AMT, and it was concluded that the F3-30 has sufficient durability for TBO extension to the next step.

Author

A92-38025

RESEARCH AND DEVELOPMENT OF TURBOFAN ENGINE FOR SUPERSONIC AIRCRAFT

SATOSHI YASHIMA Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 1, Jan. 1992, p. 1-6. In Japanese. refs

A turbofan engine with an afterburner called IHI-17 was designed and manufactured for research on a powerplant of a supersonic aircraft. Although the engine size is relatively small, the fighter engine specification was applied to its design. Various engine tests have been carried out since 1988 and component rig tests were also executed. Such technologies as three-dimensional CFD for the compressor and the turbine aerodynamic designs, air blast fuel atomizer for the high temperature combustor, an afterburner and FADEC have been developed through this program. New materials like single crystal and powder metallurgy were applied to the turbine and new

manufacturing technologies like the deep chemical milling duct and the machined ring combustion liner were also developed. The engine has demonstrated its target performance and system integration technologies of the afterburner engine have been obtained. Author

A92-42800

A QUICK AUTOMATIC METHOD FOR COMPUTING PERFORMANCE OF DUCTED-PROPELLER

SHIGENORI ANDO and MICHIO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 302-308. In Japanese. refs

A quick automatic method for computing aerodynamic performance of ducted propellers is presented. The thrust- and power-coefficients and propulsive efficiency are calculated and plotted against the advance ratio. The representative blade section is investigated. It is found that the most suitable section is one at 75-percent radius as the same as nonducted cases. Thrust coefficient is predicted satisfactorily. But propulsive efficiency is overestimated; the difference seems to be 'blower efficiency' defined in a previous paper. Author

A92-43195

WIND TUNNEL TEST FOR A HIGH SPEED PROPELLER WITH COAXIAL CONTRAROTATION

SHIGERU SAITO, M. HASHITADE (Institute of Space and Astronautical Science, Sagami-hara, Japan), M. NAKAMURA (National Aerospace Laboratory, Tokyo, Japan), KANICHI AMONO, M. SAITO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) et al. IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 444-447. In Japanese.

The configurations of the wind tunnel test equipment are presented. The test method is given and the measurement of the contrarotating propeller is discussed. Test data are analyzed and the thrust characteristics of the propeller are illustrated. Y.P.Q.

A92-43196

AERODYNAMIC DESIGN OF AN ADVANCED TURBOPROP USING EULER CODES

R. TAKAKI and MAKOTO KOBAYASHI (Kyoto University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 448-451. In Japanese. refs

The usefulness of Euler equations for aerodynamic design of an advanced turboprop is presented. The TVD scheme and boundary conditions are given and computational grids are analyzed. The pressure distribution on a blade is illustrated. Y.P.Q.

A92-43233

EXPERIMENTAL OPERATION OF AIRCRAFT-ENGINE TURBINE BLADE MATERIALS

SEIWA WATANABE (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 596-599. In Japanese.

The structure of the JT9D-7A engine is introduced. Its first stage turbine blade (PWA-1455) life control program countermeasure for thermal fatigue rupture is analyzed. Y.P.Q.

A92-43239

RESEARCH ON A LOW-NOISE ENGINE FOR A HIGH-SPEED VTOL AIRCRAFT

MASANORI ENDOH, K. SAITO, and YUKIO MATSUDA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 620-623. In Japanese.

The system structure and design configurations of a low-noise engine for a high speed VTOL aircraft are presented. The relationship among thrust, fuel consumption rate, and Mach number

is analyzed. The main characteristics and configurations of the VTOL aircraft are given. Y.P.Q.

A92-44524

EFFECTIVENESS OF PLASMA TORCHES FOR IGNITION AND FLAMEHOLDING IN SCRAMJET

YUKINORI SATO, MASAMI SAYAMA, KATSURA OHWAKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), GORO MASUYA, TOMOYUKI KOMURO, KENJI KUDOU, ATSUGO MURAKAMI, KOUICHIRO TANI, YOSHIO WAKAMATSU, TAKESHI KANDA (National Aerospace Laboratory, Miyagi, Japan) et al. Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 4, July-Aug. 1992, p. 883-889. Previously cited in issue 20, p. 3092, Accession no. A89-46927. refs

Copyright

A92-44734

NUMERICAL SIMULATION OF IMPACT RESISTANCE ON COMPOSITE BLADE

TOSHIHIRO KAWASHIMA, YASUYUKI TANAKA, and TADASHI NATSUMURA Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 2, March 1992, p. 117-122. In Japanese. refs

In the field of advanced aeroengine development, composite material holds an important position due to its high specific strength. In particular, weight reduction due to the use of FRP (Fiber Reinforced Plastics) in fan blades permit the use of larger scale fans, thus leading to more efficient engines. Fan blades are required to have prescribed impact resistance to foreign object ingestion. Numerical simulations and experimental tests have been conducted to investigate the impact failure modes and mechanisms in FRP plate and blade models. The results suggest that flexural wave propagation causes lamination failure. Furthermore, numerical simulation shows the presence of the 'edge wave', a wave which causes damage in leading and trailing edges of FRP blade. A damage prevention method which suppresses the edge wave response was examined. An analytical approach to impact resistance design is recommended. Author

A92-45430

IMPACT RESPONSE OF COMPOSITE UHB PROPELLER BLADES

NOBUO TAKEDA (Tokyo, University, Japan), YOSHIFUMI KAWAKAMI, and REIMON KOBAYASHI (Sumitomo Precision Products Co., Ltd., Amagasaki, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 607-617. refs (SAE PAPER 912046) Copyright

Thirteen kinds of composite plate specimens, including hybrid laminates composed of CFRP and GFRP, were studied by impact testing in cantilever support conditions in order to evaluate their suitability for UHB propeller blades. Teflon projectiles weighing 37 g collided with the specimens at speeds ranging from 20 m/s to 150 m/s. The direction of the projectiles was varied to investigate the effect of impact direction on the specimen response. The strain time histories of the rectangular plate specimens and flat blades were measured and compared with calculations made using the FEM program DYNA3D. As a result of these studies, a hybrid laminate as tough as GFRP was selected as a candidate for the shell material of propeller blades. C.D.

A92-45431

AN ANALYSIS OF THE EFFECT OF CENTRIFUGAL FORCE ON THE IMPACT RESISTANCE OF COMPOSITE FAN BLADES FOR TURBO-FAN ENGINES

TOSHIO MIYACHI, HIDEHITO OKUMURA, and KUNIHICO OHTAKE (National Aerospace Laboratory, Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 619-626. refs (SAE PAPER 912047) Copyright

07 AIRCRAFT PROPULSION AND POWER

In the context of a study of the impact-resistance capacity of composite-material blades for turbofan engines, attention has been given to the effect of centrifugal loading on blade structural response to impact. FEM was used to investigate the bird-strike-generated transient deformations of six different fan-blade types employing various material systems and dimensions. While centrifugal forces significantly reduced the global deformations of the heavier blades studied, local deformations were virtually unaffected. In the case of lighter blades, even the global effects of centrifugal force were negligible. O.C.

A92-45432

FINITE ELEMENTS ANALYSIS OF FLEXURAL EDGE WAVE FOR COMPOSITE FAN BLADES

HIDEHITO OKUMURA, TOSHIO MIYACHI, MASAHIRO FUKUDA, TAKASHI NAKAMURA, and KUNIHICO OHTAKE (National Aerospace Laboratory, Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 627-634. refs (SAE PAPER 912048) Copyright

The paper presents a geometrically nonlinear finite element analysis of the dynamic behavior of flexural edge waves of a composite jet-engine fan-blade model. It is shown that computer graphics technology was very efficient to visualize the mode of the edge wave generation and propagation. Results of computer simulation of a composite fan blade subjected to local impact loading with foreign objects (such as gravel, hailstone, or nuts and bolts) confirmed the existence of flexural edge wave in the region of the leading edge and the trailing edge. I.S.

A92-48878#

A SCRAMJET NOZZLE EXPERIMENT WITH HYPERSONIC EXTERNAL FLOW

SHIGEYA WATANABE (National Aerospace Laboratory, Chofu, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 10 p. refs (AIAA PAPER 92-3289) Copyright

The effect of the interaction of an engine exhaust with a hypersonic external flow on the performance of a scramjet nozzle was investigated in tests carried out in the NAL hypersonic wind tunnel with freestream Mach number of 7.1, whose freestream constitutes the external flow. Room-temperature air was used as the simulated engine exhaust flow. Model surface pressure and Pitot pressure distributions in the flowfields were measured, and flow visualization was performed using several techniques. It was found that the external flow restrains the outward expansion of the exhaust and delays the boundary layer separation on the ramp side regions and near the ramp aft end. The spanwise expansion of the exhaust flow can be greatly restrained by using long side fences. I.S.

A92-48879#

EXPERIMENTAL VALIDATION OF SCRAMJET NOZZLE PERFORMANCE

TOHRU MITANI, KOICHIRO TANI, SHIGERU SATO, HIROSHI MIYAJIMA (National Aerospace Laboratory, Kakuda, Japan), MASASHI MATSUMOTO, and SHOUHACHI YASU (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 8 p. refs (AIAA PAPER 92-3290) Copyright

Thrust by scramjet nozzles was measured using high temperature gas flow with a Mach No. of 2.5 and a total temperature of 3100 K produced by combustion of monomethyl hydrazine (MMH) and nitrogen tetroxide (NTO). Wall pressure on the nozzles was monitored at more than 150 points to estimate the pressure force on the nozzles. In order to validate experimental technique and numerical codes, a series of cold nitrogen (N₂) flow tests was also conducted using the same nozzle. An inviscid two-dimensional kinetic code was able to reproduce nozzle performance of cold N₂ flow within a discrepancy of 6.6 percent. The calculation also agreed with the experimental results of hot MMH/NTO flow within

an error of 3.6 percent, if the energy release loss in the gas generator. Kinetic, two-dimensional and friction losses in scram nozzles were identified for the nozzle, and effects of scale on performance on a scramjet nozzle for H₂-fuel engines are discussed. Author

A92-49119#

CONCEPTUAL STUDY OF SEPARATED CORE ULTRA HIGH BYPASS ENGINE

Y. SAITO, M. ENDOH, N. SUGAHARA, and K. YAMAMOTO (National Aerospace Laboratory, Chofu, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 7 p. Research supported by Ishikawajima-Harima Heavy Industries, Ltd., Kawasaki Heavy Industries, Ltd., and Fuji Heavy Industries, Ltd. (AIAA PAPER 92-3775) Copyright

An application-evaluation study is presented for a novel, 'separated-core' engine configuration for aircraft propulsion in which a turbojet primary or 'core' powerplant furnishes compressed air via pneumatic duct to remotely located secondary propulsors such as an ultrahigh-bypass fan, which are turned by burning fuel in a dedicated combustor/turbine system via reduction gearbox. Attention is given to the case of a VTOL transport concept whose secondary propulsors encompass both a pair of cruise-flight turbofans and a set of six vertical-thrust lift-fans; a battery of three core turbojets is used to supply the requisite compressed air to all secondary units. O.C.

A92-49120#

DESIGN AND OFF-DESIGN POINT CHARACTERISTICS OF SEPARATED CORE ULTRA HIGH BYPASS ENGINE (SCUBE)

YUKIO MATSUDA, NANAHISA SUGIYAMA, YOSHIO SAITO, and MASANORI ENDOH (National Aerospace Laboratory, Chofu, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 8 p. refs (AIAA PAPER 92-3776) Copyright

Separated Core Ultrahigh Bypass Engine (SCUBE) is an innovative propulsion system suited for subsonic aircraft, especially for VTOL aircraft, and has many advantageous characteristics compared to conventional engines. This paper describes the design- and off-design-point characteristics of SCUBE. SCUBE consists of two units, core engine and fan engine. Performance of core engine and fan engine are investigated under several conditions, and preferable core and fan engines for SCUBE may be defined. Assuming an aircraft with (weight) = 40,000 kg, (lift/drag) = 10 and required cruise thrust = 39.2 kN, design and off-design point characteristics of SCUBE, including transient performance, are described. Even though using engine component data based on the current technology level, the performance of SCUBE is advantageous compared to that of conventional turbofan engines, and no defect exists to realize SCUBE from the viewpoint of performance. Author

A92-53181

NEW-TYPE OF ULTRALIGHT FLEXIBLE A-SI SOLAR CELL AND ITS APPLICATION ON AN AIRPLANE

Y. KISHI, H. INOUE, H. TANAKA, S. KOUZUMA, K. MURATA, S. SAKAI, M. NISHIKUNI, K. WAKISAKA, H. SHIBUYA, H. NISHIWAKI (Sanyo Electric Co., Ltd., Hirakata, Japan) et al. IN: IEEE Photovoltaic Specialists Conference, 22nd, Las Vegas, NV, Oct. 7-11, 1991, Conference Record. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1213-1218. refs Copyright

An ultralight flexible a-Si solar cell fabricated on a transparent film substrate has been developed. High photoconductivity of $2 \times 10^{-5} \text{ Ohm/cm}$ and high photosensitivity of $1 \times 10^{-6} \text{ exp 6}$ were obtained with a-Si films deposited by H₂-dilution of SiH₄ on a transparent film substrate at 180 C. Prebaking the transparent film substrate effectively reduced the impurity content of the a-Si film. A maximum output power of 550 mW and a power-to-weight ratio of 275 mW/g were obtained for an integrated-type a-Si solar cell with a size of 110 x 115 mm. As a the first application of this

flexible a-Si solar cell, a solar-powered airplane has been developed, and it completed a transcontinental flight across the United States. I.E.

**A92-53487
DEVELOPMENT STUDY ON AIR TURBO-RAMJET ENGINE
FOR SPACE PLANE**

NOBUHIRO TANATSUGU, YOSHIHIRO NARUO (Institute of Space and Astronautical Science, Sagami-hara, Japan), and TAKEKAZU HONDA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 261-266. refs
Copyright

The expanded cycle air turbo-ramjet engine named Atrex, which is suitable for a space plane, is discussed. The design configurations and performance characteristics of the Atrex engine are described. The development study, which is to be implemented by a three-step verification test, is examined. These tests include a sea level static test, a hypersonic simulation test in a wind tunnel, and an actual flight test with a flying test bed. C.D.

**A92-53490
CONCEPTUAL DESIGN OF SCRAMJET ENGINE**

NOBUO CHINZEI, GORO MASUYA, MASAYUKI NIINO, YOSHIO WAKAMATSU (National Aerospace Laboratory, Kakuda, Japan), TEIICHI TAMAKI, TAMOTSU SAITOH, and YASUNORI OHMORI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 281-287. refs
Copyright

The scramjet engine is considered as an appropriate propulsion system for hypersonic transport and space plane flying over Mach 4. The fundamental requirement of this engine is an integrated design with airframe which is to be utilized as a part of the engine to achieve minimum drag and better specific impulse. Here, the airframe-integrated scramjet is taken as an example and the conceptual design of the engine is performed with emphasis on the performance and thermal structural analysis. Author

**A92-53491
KEY DESIGN CONSIDERATIONS FOR SCRAMJET POWERED
SPACE PLANE**

KUNIHISA EGUCHI, TSUTOMU FUJIWARA, TATSUO YAMANAKA (National Aerospace Laboratory, Tokyo, Japan), MASAOKI MATSUHARA, MORITO TOGAWA, YOICHIRO MIKI, and TATSURU TOKUNAGA (Mitsubishi Heavy Industries, Ltd., Nagoya Guidance and Propulsion Systems Works, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 289-296. refs
Copyright

A parametric performance analysis of a scramjet-powered hypersonic vehicle is reported. Fuel kinetic energy and mass addition is found to make a significant contribution to overcoming a large energy loss during the scramjet-boosted flight beyond Mach 20. Improving the propulsive performance by hot hydrogen injection results in preferable reduction of fuel consumption, providing a margin of payload and structure weight. It is concluded that fuel-rich scramjet operation should be chosen for high-speed flight because of the reduced cooling requirements and augmented thrust power. C.D.

**A92-53492
SCRAMJET ENGINE AND ITS FLYING TEST BED**

MASAYUKI NIINO, YOSHIO WAKAMATSU, NOBUO CHINZEI, GORO MASUYA (National Aerospace Laboratory, Kakuda, Japan), KOICHI YONEMOTO, and KENJI FUJIWARA (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing,

Inc., 1990, p. 297-302. refs
Copyright

The concept of a subscale scramjet engine is introduced. The engine dimensions and fuel system are summarized, and a flight test feasibility study is discussed. A conceptual design for a winged flying test bed is briefly presented. C.D.

**A92-53493
PERFORMANCE ANALYSIS OF IDEALIZED SCRAMJET**

YOSHIO WAKAMATSU, GORO MASUYA, TAKESHI KANDA, NOBUO CHINZEI, and AKIO KANMURI (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 303-308. refs
Copyright

An idealized scramjet is proposed and its behavior is theoretically examined. The performance of the scramjet for the air heating and combustion cycles agree closely. The effects of combustion and nozzle efficiency are great while those of stagnation pressure recovery efficiency is very small. At an equivalence ratio greater than unity, the thrust coefficient increases moderately but the specific impulse decreases rapidly. C.D.

**A92-54134#
AN ADVANCED SCRAMJET PROPULSION CONCEPT FOR A
350 MG SSTO SPACE PLANE - EXTERNAL NOZZLE
PERFORMANCE**

KUNIHISA EGUCHI, TSUTOMU FUJIWARA, TATSUO YAMANAKA (National Aerospace Laboratory, Tokyo, Japan), YOICHIRO MIKI, TATSURU TOKUNAGA, and MORITO TOGAWA (Mitsubishi Heavy Industries, Ltd., Aichi, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 8 p. refs
(AIAA PAPER 92-3719) Copyright

Analytical results of the thrust and lifting forces, and pitching moments on a 350 MG space vehicle over the required flight region are described. Calculations of large expansion flows are performed, in which the assumed nozzle inlet conditions are derived from a 1D thermodynamic analysis based on an optimum compression Brayton cycle theory with isobaric combustion. The thrust and lift forces generated by nozzle flow expansion may be greatly influenced by the combustor exit pressures, depending on the forebody compression, vehicle attack angles and flight altitudes. R.E.P.

**A92-55500
DEVELOPMENT OF ITS90 SMALL GAS TURBINE ENGINE**

MITSUHARA OHMOMO and YOSHIYUKI YUMITE (Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 3, May 1992, p. 197-201. In Japanese. refs

Attention is given to the ITS90 small gas turbine engine, which was developed as a demonstrator model for the engineering evaluation of a new type of small gas turbine widely applicable to aircraft, land, and marine use. The engine exhibits excellent performance as an aircraft engine gas turbine. Test results showed satisfactory performance and operation of fuel and oil systems and structure. Development specifics, engine features, special applied technology, and details of test results are presented. C.A.B.

**A92-56805#
A MODEL STUDY ON DIFFUSER PRESSURE RECOVERY IN
NAL SCRAMJET TEST FACILITY WITH SIMULATED
HYDROGEN COMBUSTION**

T. KUROSAKA, T. YAMAMURA, S. IWAGAMI (Kobe Steel, Ltd., Hyogo, Japan), J. L. GRUNNET, K. HAYAKAWA (Fluidyne Engineering Corp., Minneapolis, MN), and H. MIYAJIMA (National Aerospace Laboratory, Miyagi, Japan) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 11 p. refs
(AIAA PAPER 92-3979) Copyright

An experimental test program was conducted to study the

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characteristics of supersonic diffuser pressure recovery for a semifreejet scramjet engine test facility. The effect of hydrogen combustion was also evaluated by injecting a supersonic air stream into the engine module model. The optimized test chamber configuration was obtained with nozzle and diffuser extensions which permitted optical measurements of the model. Test results with simulated hydrogen combustion indicate that the test chamber pressure can be maintained below the nozzle exit pressure with hydrogen injection. The diffuser thermal choke, however, will restrict the operational equivalence ratio to below 0.8 at a simulated Mach number of 4 and more than 1.5 at Mach 6. V.L.

A92-57098

TESTS RESULTS ON AIR TURBO RAMJET FOR A FUTURE SPACE PLANE

NOBUHIRO TANATSUGU, YOSHIHIRO NARUO (Institute of Space and Astronautical Science, Sagami-hara, Japan), and ITARU ROKUTANDA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. refs (IAF PAPER 92-0657) Copyright

The current status of the Air Turbo Ramjet (ATR) development program initiated in Japan in 1986 is reviewed. The ATR engine being developed is a combined cycle air-breathing propulsion system consisting of a turbojet and a fan boosted ramjet using liquid hydrogen as a fuel. With the introduction of an expander cycle, the engine system has been named ATREX. The ATREX is energized by thermal energy extracted regeneratively in both the precooler installed in the air intake and the heat exchanger in the combustion chamber. Results of the testing of the ATREX-500 engine in the sea level static condition are presented. V.L.

A92-57099

AIRBREATHING ENGINE SELECTION CRITERIA FOR SSTD PROPULSION SYSTEM

Y. OHKAMI (Tokyo Institute of Technology, Japan), T. YAMANAKA, and M. MAITA (National Aerospace Laboratory, Chofu, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p. refs (IAF PAPER 92-0658) Copyright

This paper presents airbreathing-engine selection criteria to be applied to the propulsion system of a single-stage-to-orbit vehicle. To establish the criteria, a relation among three major parameters, i.e., delta-V capability, weight penalty, and effective specific impulse of the engine subsystem, is derived as compared to these parameters of the LH2/LOX rocket engine. The delta-V capability is defined by the velocity region starting from the minimum operating velocity up to the maximum velocity. The system parameters are computed by iteration based on the Newton-Raphson method. It is concluded that performance in the higher velocity region is important. A SCRAM engine system is promising if it operates up to 5000 km/sec or more. Author

N92-10025# National Aerospace Lab., Tokyo (Japan).

TEST APPARATUS AND TENSILE PROPERTIES OF LE-7 TURBINE BLADE MATERIALS IN HIGH PRESSURE HYDROGEN CONDITIONS

MAKOTO YOSHIDA (National Aerospace Lab., Kakuda (Japan).), YOSHIKI WATANABE (National Aerospace Lab., Kakuda (Japan).), YOSHIMASA TAJIMA (National Space Development Agency, Tokyo (Japan).), and KENJIRO KAMIJO (National Aerospace Lab., Kakuda, Japan) Jan. 1991 21 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1092) Avail: CASI HC A03/MF A01

A launch vehicle, the H-II, was developed. This vehicle uses a large liquid oxygen (LOX) liquid hydrogen (LH2) engine, the LE-7. The turbine blades of LE-7 LOX/LH2 turbopumps are subjected to great thermal stress due to the temperature changes during the start sequence which increases from approx. the LOX temperature to greater than the hydrogen rich combustion gas temperature (900 K) within a few seconds, with the turbine blades being exposed to drafts of cold hydrogen gas during the preburner

cutoff. At steady state operation, the LOX turbopump is driven by high pressure, hydrogen rich, hot combustion gas, thus the turbine blades must be strong enough to withstand not only thermal stress but also high pressure hydrogen embrittlement. Much research has focussed on industrial application hydrogen embrittlement effects, however, rocket turbopump hydrogen embrittlement must be studied in more detail. This led to the construction of a hydrogen embrittlement test facility to perform fatigue and tensile tests of blade materials in high pressure hydrogen at high temperatures, thereby actually simulating actual turbine driving conditions. Both Inconel 718 and MAR-M247 LC DS were tested using this facility, with the former being used as a disk material for the integrally machined blades of research, prototype, and flight models, whereas the latter is being used for prototype/flight model turbopump turbine blades. Author

N92-13068# National Aerospace Lab., Tokyo (Japan).

LOW OXYGEN COMBUSTION TESTER FOR HIGH TEMPERATURE REHEAT COMBUSTORS

SHUJI YAMADA, KAZUO SHIMODAIRA, and MASASHI HORIUCHI Apr. 1989 17 p In JAPANESE; ENGLISH summary

(DE90-505516; NAL-TM-605) Avail: CASI (US Sales Only) HC A03/MF A01

As a part of the development of high efficiency reheat cycle gas turbines, the combustion tester capable of testing under various oxygen content conditions at a combustor inlet was developed to examine the flame holding, combustion, and emission characteristics of combustors in high temperature low oxygen combustion. The tester allowed to supply the gas of low oxygen content (11 percent) and 1086 K for combustion experiments of a half scale combustor model. The oxygen content of air was reduced to 11 percent by using an existing aeroplane gas turbine combustor as a preheat combustor. The temperature of as-preheated gas (1500 K) was lowered with the latent heat of the water injected into the gas in a water-evaporizing cooler, and temperature profiles were obtained from the gas sampled at the combustor exit. The experimental results show that the cooler could efficiently obtain the required gas temperature at pressures of 5-8 atm and at an air/water ratio of 10 (nearly equal to design specifications). DOE

N92-15071# Universal Technology Corp., Dayton, OH.

DOMESTIC AND FOREIGN TRADE POSITION OF THE UNITED STATES AIRCRAFT TURBINE ENGINE INDUSTRY. TASK SIX: SHORT-TERM GAS TURBINE PROPULSION ANALYSIS AND ASSESSMENT Interim Report, Sep. 1989 - Aug. 1990

H. I. BUSH and RANDOLPH W. SPRATT Jun. 1991 181 p (Contract F33615-88-C-2823)

(AD-A242646; WL-TR-91-2066) Avail: CASI HC A09/MF A02

U.S. aircraft engines and parts imports/exports are traced through the 70's and 80's, showing a trend that, if continued, will position the U.S. as a net importer of engines and parts by the turn of the century. New engine production between 1970 and 1988 is traced and comparisons made between the U.S. and other western world countries. The U.S. share in engine production eroded from 84 percent in 1970 to 62 percent in 1988, while the European Community (E.C.) more than doubled its share (15 to 32 percent). Changes in market character are reviewed (military/civil segments and coproduction growth). The machine tool industry's rise in Japan and its collapse in the U.S. is reviewed to identify conditions that also may characterize the U.S. engine industry. The U.S., E.C., and Japanese aircraft engine industries are briefly compared to highlight causes for the U.S. erosion and E.C. gain. Conclusions are drawn regarding the U.S. aircraft engine industry's trade position, and recommendations are offered for activity to assure that U.S. engines are produced with superior quality to lower cost than can be achieved by any of its international competitors for the foreseeable future. GRA

N92-17855# National Aerospace Lab., Tokyo (Japan).
Aeroengine Div.

HYDROGEN FUELED SUBSONIC-RAM-COMBUSTOR MODEL TESTS FOR AN AIR-TURBO-RAM ENGINE
TAKASHI TAMARU, KAZUO SHIMODAIRA, TAKASHI SAITOH, HIDESHI YAMADA, and SHOUJI HORIUCHI Apr. 1990 14 p
Previously announced in IAA as A90-12529
(ISSN 0389-4014)

(NAL-TR-1064T; JTN-92-80298) Avail: CASI HC A03/MF A01

This paper deals with a basic study to facilitate the design of the hydrogen fueled subsonic ram combustor. Three types of flame holders, scaled 1/10 of the estimated actual size, were investigated to evaluate the performance for severe inlet conditions of hypersonic flight. Unidimensional analysis with total pressure at the exit and the static pressure on the duct wall gave the gas temperature and the Mach number of the combustion gas. Analysis of sampled gas at the exit gave radial profiles of equivalence ratio, combustion efficiency and so on. These results indicate that the fuel rich zone over stoichiometry must be avoided for the fuel preparation to attain the best combustion efficiencies near the stoichiometric mixture condition which is required for the engine in hypersonic flight. Author (NASDA)

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A92-14027
DEVELOPMENT AND FUTURE VIEW OF THE TECHNOLOGY FOR FLY-BY-LIGHT CONTROL SYSTEM ELEMENTS
MITSUYOSHI MAYANAGI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 450-457. In Japanese. refs

Development of the technology for fly-by-light control systems is reviewed. The optical sensor and optical data bus are discussed and their performance features are listed. Flight test results are reported. Y.P.Q.

A92-18621
STRUCTURE/CONTROL DESIGN SYNTHESIS OF ACTIVE FLUTTER SUPPRESSION SYSTEM BY GOAL PROGRAMMING
SHINJI SUZUKI (Tokyo, University, Japan) and SEIJI MATSUDA (Nissan Motors Co., Ltd., Tokyo, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 14, Nov.-Dec. 1991, p. 1260-1266. Previously cited in issue 21, p. 3330, Accession no. A90-47587. refs
Copyright

A92-22520
EVALUATION METHOD OF LONGITUDINAL STATIC STABILITY OF TAILLESS AIRPLANE
SHIGENORI ANDO and HIROSHI KAJITA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 14-22. In Japanese. refs

Static longitudinal stability of tailless airplane is evaluated theoretically with two methods. One is the quasi-strip (or modified strip) method, and the other is a lifting-surface theory (DLM). Computation is made on the basis of available data of Northrop XB-35. Both methods agree with each other only qualitatively; of course, results of DLM should be much more reliable. Allowable limit of longitudinal CG position may be almost comparable with that of conventional airplanes. The airplane efficiency factor, e , relating to induced drag, is computed which is also satisfactory at least for cruising configuration. Author

A92-29516
APPLICATION OF THE DELTA-OPERATOR IN MIMO DISCRETE-TIME ADAPTIVE FLIGHT CONTROL SYSTEMS
YOSHIMASA OCHI, KIMIO KANAI, and YASUO KISHIMOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 457, 1992, p. 78-84. In Japanese. refs

A transfer function of an aircraft for some input and output has the relative degree of two or more. In such a case, it is known that unstable zeros, which are called limiting zeros, can appear when the system is discretized at a fast sampling rate. In an MIMO case, the inverted system can be unstable if the transfer functions have unstable limiting zeros. This fact makes it difficult or impossible to apply the MRACS to the design of the flight controller. In order to overcome this problem, application of the delta-operator is considered, and the numerical simulations show the usefulness of this approach. Author

A92-30549
SAFETY TEST ON THE ROLLING ANGLES OF A WINGED VEHICLE IN HYPERSONIC SPEED

A. YOSHINAGA, TOKUSHI TATE, SHIGEYA WATANABE, and K. WATANABE (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 184-187. In Japanese. refs

The space plane model for wind tunnel test is presented. The rolling angles of a winged vehicle in hypersonic speed are analyzed. Test results are examined. Y.P.Q.

A92-39910
ROBUST FLIGHT CONTROL SYSTEM DESIGN WITH MULTIPLE MODEL APPROACH

YOSHIKAZU MIYAZAWA (National Aerospace Laboratory, Chofu, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 785-788. Previously cited in issue 21, p. 3316, Accession no. A90-47666. refs
Copyright

A92-43112
STUDY ON A FLIGHT SIMULATOR OF TIME DELAYS

K. OCHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 96-99. In Japanese. refs

Digital computer technology for the improvement of a flight simulator is discussed. The time delay effectiveness of the flight simulator is presented. The pilot induced oscillation and time delay response are addressed. Y.P.Q.

A92-43115
FLIGHT EVALUATIONS ON IN-FLIGHT SIMULATION OF UNSTABLE AIRCRAFT

YUKIICHI TSUKANO and S. INAGAKI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 108-111. In Japanese. refs

In-flight simulation tests for aircraft control and stable systems are evaluated. The variable stability and response aircraft (VSRA) is used for flight test in order to identify the stability and control derivatives. Stable evaluation for visual observation is analyzed. Y.P.Q.

A92-43120
MULTIHARMONIC CONTROL RESPONSE OF A ROTOR BLADE DURING FORWARD FLIGHT (TEST)

GIZO HASEGAWA and TOMOARI NAGASHIMA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 128-131. In Japanese. refs

The vibration reduction of the rotors is presented. The

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configuration of the test facility is described, and control pitch angles and payload changes are defined. Fast Fourier transform (FFT) analysis for obtained spectral analytic results is presented.

Y.P.Q.

A92-43121

MULTIHARMONIC CONTROL RESPONSE OF A ROTOR BLADE DURING FORWARD FLIGHT (ANALYSIS)

GIZO HASEGAWA, TOMOARI NAGASHIMA, and TOSHIFUMI NEKOHASHI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 132-135. In Japanese. refs

A rotor rear flow model is used to study vibration reduction. The Loewy and Miller method is given for the analysis of multiharmonic control response. Rotor shapes are analyzed, and analytic results are presented.

Y.P.Q.

A92-43127

STUDY ON AN INDUCTION METHOD FOR A FLYING OBJECT, TAKING ACCELERATING TARGETS INTO ACCOUNT

YORIAKI BABA, MAKOTO YAMAGUCHI, and KICHIRO TAGAO (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 156-159. In Japanese. refs

An induction method for the proportional navigation is outlined. The mutual position of the target and the flying object is analyzed. The development of the simple tracking navigation method is described.

Y.P.Q.

A92-43128

AIRCRAFT EVASIVE MANEUVERS AGAINST FLYING OBJECTS

TAKESHI KURODA and FUMIAKI IMADO (Mitsubishi Electric Corp., Amagasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 160-163. In Japanese. refs

The equations of motion for the calculation of aircraft evasive maneuvers is presented. The positional relationship between an aircraft and a flying object is analyzed. Computational results show the optimum evasive maneuver in the case of one aircraft with a flying object or two aircraft with a flying object.

Y.P.Q.

A92-43129

THREE-DIMENSIONAL GAME FOR TWO AIRCRAFT

FUMIAKI IMADO and T. ISHIHARA (Mitsubishi Electric Corp., Amagasaki, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 164-167. In Japanese. refs

The application of nonlinear optimum control theory to the 3D game for two aircraft is discussed. The mathematical model is given, and the aircraft maneuvers are computed. The tactical control method is addressed.

Y.P.Q.

A92-43131

STEP RESPONSE OF INCOMPRESSIBLE UNSTEADY AERODYNAMIC MODELING

SHINJI SUZUKI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 172-175. In Japanese.

Active flutter suppression (AFS) and gust load alleviation (GLA) control systems are presented. Normal aerodynamic step response and the transformation of the state equations are described. Computing results on the step response of incompressible unsteady aerodynamics are analyzed.

Y.P.Q.

A92-43134

GUST LOAD ALLEVIATION CONTROL DESIGN FOR THE ACCURACY OF AN AEROELASTIC ACTIVE CONTROL MODEL
K. FUJII, YOSHIKAZU MIYAZAWA, and H. MATSUSHITA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium,

28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 184-187. In Japanese. refs

Research on active control technology (ACT) for gust load alleviation (GLA) is discussed. Test equipment for the GLA is introduced and equations describing the GLA is considered. A mathematical model for the control design is analyzed.

Y.P.Q.

A92-43135

ACT WIND TUNNEL EXPERIMENT ON GUST LOAD ALLEVIATION. II - WIND TUNNEL TEST WITH ACTIVE SUPPORT FACILITY

H. MATSUSHITA, K. FUJII, and S. SUZUKI (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 188-191. In Japanese. refs

A dynamic model support facility for an ACT (active control technology) wind tunnel test is presented. The flutter margin characteristics of the gust load alleviation (GLA) control are discussed. The linear quadratic Gaussian (LQG) method is used for the design of the optimum control.

Y.P.Q.

A92-43146

PATH ANGULAR CONTROL OF THE STOL RESEARCH AIRCRAFT ASUKA

NORIAKI OKADA, TOKIO KASAI (National Aerospace Laboratory, Chofu, Japan), and H. TSUJIMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 240-243. In Japanese.

The path angular control of the STOL research aircraft Asuka is described. The development of the path angular control model is described.

Y.P.Q.

A92-43159

AN ADAPTIVE FLIGHT CONTROL FOR USE IN CONNECTION WITH HELICOPTER ENGINE FAILURE

YOSHINORI OKUNO (National Aerospace Laboratory, Tokyo, Japan) and KEIJI KAWACHI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 296-299. In Japanese. refs

A92-43175

AN EXTENDED GUIDANCE LOOP AND THE STABILITY OF THE HOMING MISSILES

TOSHIYUKI TANAKA and HIROFUMI EGUCHI (Japan Defense Agency, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 362-365. refs

The hyperstability is a kind of the inner stability. A hyperstable range had been defined as a relative range that keeps the hyperstability of the guidance loop after launch off. This paper introduces a new concept named an extended guidance loop, analyzes the input-output stability (L2-stability) of the loop, and proves that the hyperstable range is the relative range that assures not only the hyperstability but also the input-output stability of the guidance loop after launch. Namely, the paper shows that the homing missile is stable until passing the hyperstable range in spite of any initial conditions or any target evasive maneuvers at the engagements. A key concept named an extended guidance loop and a guidance loop stable theorem are the principal results of this paper.

Author

A92-43180

ROBUST FLIGHT CONTROL SYSTEM DESIGN USING A MULTIMODEL APPROACH. II

Y. MIYAZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 384-387. In Japanese. refs

A theoretical evaluation of a flight control system is presented. The slow mode of aircraft longitudinal dynamics is discussed. Computational results are given. Y.P.Q.

A92-43182
MODEL REFERENCE ADAPTIVE FLIGHT CONTROL SYSTEM (MRAFCS) DESIGN WITH CONSIDERATION OF THE BALANCE POINT

H. KATO, T. SAKAI, and YUZO SHIMADA (Nihon University, Funabashi, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 392-395. In Japanese. refs

A design methodology for a model reference adaptive flight control system (MRAFCS) is presented. The microdisturbance functions and aircraft motion equations are discussed. The pattern derivation of the adaptive control system is considered, and results of numerical simulation are presented. Y.P.Q.

A92-43183
STUDY OF THE FLIGHT CONTROL OF REMOTELY PILOTED HELICOPTERS

F. HANE and KISHI YAMAMOTO IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 396-399. In Japanese. refs

The aerodynamics of a remotely piloted helicopter is discussed. The characteristics of the control system are described. Y.P.Q.

A92-43184
A RESTRUCTURABLE FLIGHT CONTROL SYSTEM DESIGN USING NONLINEAR COMPENSATION

YOSHIMASA OCHI and KIMIO KANAI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 400-403. In Japanese. refs

The state and power equations of nonlinear compensation for a restructurable flight control system (RFCS) are presented. The thrust control and input vibration suppression are described. The time responses for thrust control and no-input/input compensation are analyzed. Y.P.Q.

A92-43185
THE ACCELERATION CONTROL SYSTEM DESIGN OF A FLIGHT VEHICLE USING A TWO-WING CONTROL METHOD
 YOSHIMASA OCHI, KIMIO KANAI, T. SAKA (National Defense Academy, Yokosuka, Japan), F. IMADO, and KEN KURODA (Mitsubishi Corp., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 404-407. In Japanese. refs

A92-43186
STABILITY OF A GUIDANCE AND CONTROL SYSTEM FOR ROLL COUPLING

HIDEHIKO KUBO, A. INAISHI, H. EGUCHI (Japan Defense Agency, Technical Research and Development Institute, Tachikawa, Japan), and TADASHI YAMASHITA (Kyushu Institute of Technology, Kitakyushu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 408-411. In Japanese. refs

The stable performance of the roll of target tracking equipment is studied. The guidance control system model is used and stability analysis and analytical conditions are examined. A covariance analysis technique is applied. Y.P.Q.

A92-43218
A STUDY OF THE PILOT'S ASSOCIATE SYSTEM

K. TANAKA and K. MATSUMOTO (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 536-539. In Japanese. refs

The functions of the cockpit advisory system (CAS) for aircraft control is presented. The ground simulator testing model and pertinent computer programs are discussed. Y.P.Q.

A92-45384
ESTIMATION OF SPACEPLANE LATERAL-DIRECTIONAL STABILITY AND CONTROL DERIVATIVES FROM DYNAMIC WIND TUNNEL TEST

MASAAKI YANAGIHARA, SEIZO SUZUKI, SHIGEO KAYABA, and KATSUICHI MUROTA (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 131-139. refs
 (SAE PAPER 911979) Copyright

Dynamic wind tunnel tests using a 5-percent cable-mounted model of the NAL spaceplane have been performed in the NAL low-speed large scale wind tunnel to identify the aerodynamic model including dynamic effects. During the test performed in March 1991, the lateral-directional motion was excited by aileron and rudder inputs. A flight path reconstruction was applied to the recorded data and a parameter identification study of the reconstructed data was undertaken to extract lateral-directional stability and control derivatives using the least square method. The estimated derivatives were compared with the results of static wind tunnel tests and theoretically estimated dynamic derivatives. They were also evaluated by comparing mathematically simulated time histories calculated using them with the wind tunnel test data. As a result, all major derivatives were estimated well and effectiveness of the dynamic test was shown. Author

A92-45450
IN-FLIGHT SIMULATION OF BACKSIDE OPERATING MODELS USING DIRECT LIFT CONTROLLER

YUKICHI TSUKANO (National Aerospace Laboratory, Chofu, Japan), MASAKI KOMODA (Tokyo Metropolitan Institute of Technology, Japan), NAGAKATU KAWAHATA (Nihon University, Chiba, Japan), and TOSHIHARU INAGAKI (National Aerospace Laboratory, Chofu, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 815-823. refs
 (SAE PAPER 912069) Copyright

Effectiveness of a direct lift controller (DLC) for in-flight simulation is discussed. When a model aircraft is operating in backside of power curve, DLC is indispensable. On the basis of this, quick-moving flaps are installed on the variable stability and response airplane of the National Aerospace Laboratory of Japan. Direct lift capability of the flaps are precisely identified. After tailoring adequate feedback/feed forward gains, a model-following system is constructed to simulate backside-operating models by a mother airplane which is operating in frontside. As an application, a flight test result for simulated landing approach in backside range is shown. Author

A92-52041
NONLINEAR DYNAMIC STABILITY CHARACTERISTICS OF RECOVERY BODIES

KEIICHI KARASHIMA and KIYOSHI SATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 462, 1992, p. 384-395. In Japanese. refs

This paper is concerned with detailed results of an experimental study on nonlinear dynamic stability of pitching motions of the various recovery bodies at a low subsonic speed. The experiment is conducted in an induction type transonic wind tunnel at Mach number of 0.2, and measurement of angular variation with time of the models is made for pitching oscillation with a finite amplitude. An approximate oscillation equation, that is formulated by use of an unsteady aerodynamic pitching-moment coefficient and, in general, is capable of predicting fairly accurately the experimental data having various nonlinear oscillatory modes, is proposed on the basis of the concept of a curve-fitting method. It is shown that the aerodynamic pitching moment and the associated nonlinear dynamic stability can be determined from the numerical simulation to the experimental data with sufficient accuracy. Author

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A92-52043

STATIC AND DYNAMIC FLIGHT-PATH STABILITY OF AIRPLANES

OSAMU KOBAYASHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 462, 1992, p. 403-411. In Japanese. refs

The concept of flight-path stability, which is today in use, is based on the characteristics of steady unaccelerated flight conditions, and so can be called 'static flight-path stability'. After the description about the static flight-path stability, this paper introduces the 'dynamic flight-path stability' concept for accelerated/decelerated flight conditions, and discusses the necessary elevator-compensation to provide an airplane with the designated dynamic flight-path stability. Furthermore, it is demonstrated that the airplane with the compensation can stably control the flight-path by the elevator in the backside flight region, through the study on the airplane's response and phugoid-mode characteristics. Author

A92-55231#

OPTIMAL CONTROL OF HELICOPTERS FOLLOWING POWER FAILURE

YOSHINORI OKUNO (National Aerospace Laboratory, Tokyo, Japan) and KEIJI KAWACHI (Tokyo, University, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 818-825. refs

(AIAA PAPER 92-4471) Copyright

Helicopters' control procedure in the event of power failure is theoretically investigated by applying nonlinear optimal control theory. Comparison between the optimal solutions and flight test results shows that the pilots used nonoptimal controls during the recovering procedure, especially in the timing and amplitude of the collective flare before touchdown, or in the pull-up maneuver when continuing flight. It is also pointed out that parameters such as wind speed, initial flight-path angle, collective pitch range, emergency landing site location, and its available field length have significant effects on safe landing and successful continued flight following power failure, although some of these effects are not taken into account during current certification flight tests. Author

A92-55248#

OPTIMAL MISSILE GUIDANCE SYSTEM AGAINST A HYPERSONIC TARGET

FUMIAKI IMADO and TAKESHI KURODA (Mitsubishi Electric Corp., Amagasaki, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 1006-1011. refs

(AIAA PAPER 92-4531) Copyright

A missile guidance system against a hypersonic target up to 10 M is studied. The missile is vertically launched from the surface and navigated to the collision course, following to the optimal trajectory calculated from nonlinear optimal control data base. The trajectory deviation caused by the missile disturbances and the unpredicted motion of the target is corrected by a linear quadratic regulator. The simulation study demonstrates that the missile can follow large trajectory variations and perform well. Calculated examples of defensible areas by a launcher for several target incidences are also shown. Author

A92-55252#

NON-GAUSSIAN CLUTTER EFFECT ON THE MISS DISTANCE OF A RADAR HOMING MISSILE

HIROYUKI ITOHARA and SUSUMU MIWA (Tokyo Denki University, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 1039-1044. refs

(AIAA PAPER 92-4536) Copyright

A non-Gaussian clutter effect on a radar homing missile is presented. In these measurements, the non-Gaussian clutter is

modeled utilizing a Weibull PDF model, and the clutter shape parameter lies between 0.5 and 2.5. Simulations are performed employing the statistical linearization adjoint method both for the cases of the no-target random maneuver and that of the 3G-target random maneuver. R.E.P.

A92-55305#

MULTIPLE DELAY MODEL APPROACH APPLIED TO THE AIAA 1992 CONTROLS DESIGN CHALLENGE

YOSHIKAZU MIYAZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 3. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 1559-1568. refs

(AIAA PAPER 92-4630) Copyright

The Multiple Delay Model and Multiple Design Point (MDM/MDP) approach is applied to the AIAA 1992 Controls Design Challenge, and a structured constant feedback is derived using this approach. The approach is compared with more complex control laws at each design point to assess its feasibility and verified against time histories of two flight simulations. The performance is evaluated at four specified points. The performance index is easily defined, and uncertainty and change of dynamics are easily represented with multiple models, and the design can be carried out with a small number of trials and errors. V.L.

A92-56021

SYNTHESIS OF GUST LOAD ALLEVIATION WITH FLUTTER MARGIN AUGMENTATION

KENJI FUJII, HIROSHI MATSUSHITA, and YOSHIKAZU MIYAZAWA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 84-87. In Japanese. refs

A synthesis method to obtain gust load alleviation control laws which also provide flutter margin augmentation is presented. The cost function introduced to synthesize the gust load alleviation control laws is equivalent to the kinetic energy, and is expected to be not only effective in gust load alleviation, but also flutter suppression. In order to enhance flutter margin augmentation, control laws were synthesized with design velocities being set higher than the estimated flutter speed. The derived control laws were analytically evaluated. Author

A92-56022

OPTIMIZATION OF AEROELASTIC SYSTEM WITH ACTIVE CONTROL

SHINJI SUZUKI (Tokyo, University, Japan) and SATOSHI YONEZAWA (KOBELCO, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 88-91. In Japanese. refs

This paper considers an optimization capability for designing airframe structures with active control system subjected to random gust loads. An aileron surface attached to a cantilevered flexible wing is actively controlled with a feedback signal of a wing acceleration to reduce gust induced stresses. A wing spar is modeled with a set of FEM bar elements to obtain the equation of motion in a first-order time-domain (state-space) form. The thickness distribution of the wing spar and a feedback gain are simultaneously optimized for gust load requirements and stability requirements to minimize the structural weight. A goal programming approach with a concept of priorities is successfully applied for multiple design requirements. Author

A92-56025

OPTIMIZATION APPROACH FOR HELICOPTER MANEUVERABILITY WITH A POINT MASS MODEL

SHIGERU SASAKI, TOSHIFUMI NEKOHASHI, and TOMOARI NAGASHIMA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 100-103. In Japanese. refs

Using a point mass approximation, maneuverability analyses of a helicopter based on optimal control theory are conducted. The problem is formulated as an optimal control problem involving differential and nondifferential constraints. The effect due to the induced velocity is evaluated by taking a power constraint into account. The optimal solution is determined numerically by the SGRA. Minimum time 180 deg turns in the horizontal plane as well as the space are discussed. The results show importance of the autorotation capability for the minimum time turn performance. Author

A92-56026**AN INVESTIGATION OF THE AUTOMATION OF EMERGENCY LANDINGS FOR HELICOPTERS**

HIROSHI SAITO and MASAKI KOMODA (Tokyo Metropolitan Institute of Technology, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 104-107. In Japanese. refs

A control system for helicopter emergency landing is presented. The neighboring optimal control is computed and the backward sweep method is used. Vertical optimal control and neighboring optimal control are compared. Y.P.Q.

A92-56027**MULTIAXIS CONTROL IN LONGITUDINAL MODE OF AIRCRAFT**

MASAKI KOMODA (Tokyo Metropolitan Institute of Technology, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 108-113. In Japanese. refs

A pitch-mode decoupling system is proposed where only limited servo bandwidth is called for. The resulting cross-coupling between airspeed and flight path control is discussed from manual control point of view. Author

A92-56028**A320 FLIGHT CONTROL FROM THE PILOT'S POINT OF VIEW**

MITSUO MORIMOTO and MASAOKI SUZUKI (All Nippon Airways, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 114-117. In Japanese.

The A320 fly by wire control system is described. Modifications introduced to facilitate pilot operation and control sense perception are discussed. Y.P.Q.

A92-56029**ROBUST CONTROL SYSTEM DESIGN WITH MULTIPLE MODEL APPROACH**

YOSHIKAZU MIYAZAWA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 118-122. In Japanese. refs

Robust control system design with a multiple-delay model approach and its application to flight control systems are discussed. The approach is based on concepts of multiple models, LQR (linear quadratic regulator), and proportional output feedback. Multiple-delay models are used to represent uncertain dynamics in the high-frequency range. Previously obtained numerical examples are reviewed, such as active flutter control, longitudinal flightpath control, and model-following flight control. The numerical examples show that the approach can directly give robust and high-performance control laws with only a few design parameters including delay times for each control input. Author

A92-56030**FLIGHT CONTROL SYSTEM DESIGN USING H(INFINITY) OPTIMAL CONTROL**

MORLO TAKAHAMA, TAKASI KIMURA, EI TOKUDA, and MASAHIRO OHNO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 122-125. In Japanese. refs

We applied the mixed sensitivity problem, which is one method of $H(\infty)$ optimal control, to design a control-augmentation system for the longitudinal flight control system of a typical small aircraft. But this method cannot achieve model matching. Thus, we propose a design method for a robust flight-control system that has a disturbance estimator using $H(\infty)$ optimal control to realize model matching. Author

A92-56031**NEW TECHNIQUES IN MISSILE GUIDANCE AND CONTROL**

FUMIAKI IMADO, TAKESHI KURODA, and TOSHIO FURUKAWA (Mitsubishi Electric Corp., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 126-129. In Japanese. refs

Flight control systems for short, medium and long range missiles are presented. Model reference adaptive control (MRAC) is analyzed, and the static stability margin is addressed for a missile having front and rear control surfaces. Proportional navigation guidance (PNG) is discussed, and an optimal regulator for calibrating the control system is outlined. Y.P.Q.

A92-56032**AN AUTOROTATION-ENTRY CONTROL FOR A HELICOPTER WITH A FUZZY CONTROLLER**

NAKOTO UEMURA, MUNENORI ISHIKAWA, NAOKI SUDO, and YOSHIHARU KUBO (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 130-133. In Japanese.

The design of a fuzzy control system for a helicopter is presented. Helicopter rate control and positional control are addressed. Simulation results are given, and the 'if-then' rule for the autorotation entry control system is discussed. Y.P.Q.

A92-56033**APPLICATION OF FUZZY CONTROL TO AIRCRAFT GUIDANCE**

TAKASHI SHINAGAWA, MASAMI MATSUDA, and KATSUYA ISHIMOTO (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 134-137. In Japanese.

A ground-control approach (GCA) for aircraft guidance is discussed. The fuzzy control system and the PD control system are compared. GCA simulation is tested and its results are evaluated. Y.P.Q.

A92-56057**ESTIMATION OF AIRCRAFT INERTIAL CHARACTERISTICS USING MAXIMUM LIKELIHOOD ESTIMATION**

HIROBUMI OHTA and HIROFUMI NISHIMURA (Nagoya University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 254-257. In Japanese.

The Lagrangian equations of motion are used to estimate aircraft inertial characteristics. The free vibration model test facility is discussed, and the maximum likelihood estimation results are analyzed. Y.P.Q.

A92-56062**SYNTHESIS OF A MLS AUTOMATIC LANDING CONTROL LAW FOR THE NAL EXPERIMENTAL RESEARCH AIRCRAFT DO-228**

TADAO UCHIDA, TOSHIHO SAKAI, TOSHIHARU INAGAKI, KOKI NOZUMI, and KAZUTOSHI ISHIKAWA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 274-277. In Japanese. refs

This paper presents a preliminary design synthesis of an automatic landing control law using the MLS for the NAL

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experimental research aircraft Do-228. The control law consisting of altitude hold, glide path tracking, and flare, has been evaluated by a digital flight simulation with turbulence. Author

A92-56064

A MIDCOURSE GUIDANCE STUDY ON A FUTURE AUTONOMOUS TACTICAL MISSILE

FUMIAKI IMADO and TAKESHI KURODA (Mitsubishi Electric Corp., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 282-285. In Japanese. refs

The optimal control theory for an autonomous tactical missile is discussed. Adaptive feedback control using a linear quadratic regulator is considered. Research on real time correction is reported. Y.P.Q.

A92-56065

NORMAL ACCELERATION CONTROL FOR A MISSILE HAVING FRONT AND REAR CONTROL SURFACES USING AN ADAPTIVE SERVO CONTROLLER

KIMIO KANAI, TAKESHI YOSHIZUKA, and OCHI YOSHIMASA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 286-289. In Japanese. refs

The design of normal acceleration control using an adaptive servo controller is presented. The structures of the control system are discussed, and a theoretical analysis of missiles having front and rear control surfaces is presented. Y.P.Q.

A92-56066

MIMO STATE-FEEDBACK CONTROL SYSTEM CONSIDERING PHASE STABILITY BY -90 DEG PHASE-LOCUS METHOD

RYOJI KATAYANAGI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 290-293. In Japanese. refs

A lateral-directional flight control system was investigated using the -90-deg phase-locus method. This method gives a state-feedback control system with highly stability robustness. The -90-deg phase-locus is that the root locus whose phase lag is 90 deg. First, pole-zeros of the system are determined to get a desired response for the closed system. Then, phase lag of each open loop transfer function is checked so as not to exceed 90 deg using -90 deg phase-locus method. Author

A92-56068

APPLICATION OF RESTRUCTURABLE FLIGHT CONTROL SYSTEM USING NONLINEAR CONTROL TO AN AIRLINER

YOSHIMASA OCHI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 298-301. In Japanese. refs

The feedback linearization method is applied to the accommodation of aircraft failures occurring at control effectors or the airframe. The failures are identified as parameter changes in the six-degree-of-freedom nonlinear equations of motion by the recursive least square method. The control parameters are updated using the latest estimated parameters. The control system is discretized considering implementation using digital computer. It was applied to an airliner and the performance was evaluated by computer simulation. Author

A92-56070

SELECTION OF SAMPLING RATE FOR NONLINEAR FLIGHT TRAJECTORY CONTROLLER OF AIRCRAFT

Y. BABA, K. SATONAKA, and K. TAKAO (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 306-309. In Japanese.

In a previous paper, the nonlinear flight trajectory controller was designed using a singular perturbation theory. Since a digital

computer is used to realize this control system, it reduces to a digital control system. In this paper, we show how to select the sampling rate for the controller. Author

A92-56079

A LOW SPEED WIND TUNNEL INVESTIGATION OF THE DIRECT SIDE FORCE CONTROL OF A JOINED-WING AIRCRAFT WITH OVERHANGING FIN

TOSHIMI FUJITA, AKIHITO IWASAKI, HIROTOSHI FUJIEDA (National Aerospace Laboratory, Chofu, Japan), HISASI SATO (Tokai University, Japan), and NAOTO TAKIZAWA IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 350-353. In Japanese.

The effectiveness of the side force control of a joined-wing aircraft with overhanging fin is presented. The upper fin shape and its model configurations are described. The direct controlled side force coefficient and composite side force coefficient are analyzed. Y.P.Q.

A92-56086

CHANGE AND RELIABILITY OF THE DC-9-81 DIGITAL FLIGHT GUIDANCE SYSTEM

TAKASHI OGATA (Japan Air System, Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 386-389. In Japanese.

The digital flight guidance computer (DFGC) system for the DC-9-81 is described. Its functions include autopilot, yaw damper, Mach trim compensation, speed control, autothrottle, and thrust rating. The continuous built-in-test and power-up test of the system are addressed, and the improvement of the DFGC is discussed. Y.P.Q.

A92-56119

AN EXPERIMENTAL STUDY ON VARIABLE PRESSURE HYDRAULIC FLIGHT CONTROL SYSTEM

TORU NAGAO, HIROYUKI KATAOKA (Fuji Heavy Industries, Ltd., Tokyo, Japan), KAZUYA KOGA, and JUN NISIOKA (Tokimec, Inc., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 532-535. In Japanese.

Characteristics and benefits of a variable pressure hydraulic flight control system with respect to energy saving and reduction of heat rejection are described. Design, development, and testing of a variable pressure system have been implemented successfully. This new concept is validated for improving efficiency. Author

A92-56303

OPTIMAL CONTROL OF TILTROTOR AIRCRAFT FOLLOWING POWER FAILURE

YOSHINORI OKUNO (National Aerospace Laboratory, Tokyo, Japan) and KEIJI KAWACHI (Tokyo, University, Japan) European Rotorcraft Forum, 17th, Berlin, Germany, Sept. 24-26, 1991, Paper. 10 p. refs

Nonlinear optimal control theory was used to study optimal control of tilt-rotor aircraft following power failure. Optimal control procedures following power failure during hover were studied with emphasis on nacelle angle control effects, by considering (1) continued flight (fly-away) following one engine failure and (2) an autorotative landing following total power failure. The fly-away optimization problem was formulated so as to minimize the initial hovering height using the terminal condition of the transition to level flight with 35 ft minimum clearance above the takeoff surface. The landing optimization problem following total power failure was formulated to minimize the initial hovering height using the terminal condition that the touchdown speed factor is within the landing gear capacity. The analytical methods proposed in this paper are expected to reduce the cost, time, and risks involved in the certification flight tests. I.S.

09 RESEARCH AND SUPPORT FACILITIES (AIR)

N92-10026# National Aerospace Lab., Tokyo (Japan). **DEVELOPMENT OF DIGITAL/OPTICAL ROTARY POSITION TRANSDUCER**

MITSUYOSHI MAYANAGI, MINORU TAKIZAWA, and TADAO UCHIDA May 1991 24 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1106) Avail: CASI HC A03/MF A01

Two different types of digital optical rotary position transducers were developed for use in future aircraft Fly-By-Light (FBL) control systems, i.e., one uses a collimated light on a code plate and the other a focussed light. These transducers can be used for sensing the pilot's control stick positions and/or control surface deflection in FBL control systems. The transducer system consists of two different transducers, four fiber cables, and an electronic interface unit having two light sources. This transducer system features the following: (1) resistance against electromagnetic interference and anti-lightning are obtained by an electrically passive transducer which uses no electronic parts; (2) connection between hardware is simplified by the use of serial digital optical signals obtained through optical pulses, optical fiber delay lines, an optical coupler, and the use of a time domain multiplexing concept; (3) system extendability is attained by using a time sharing processing hardware in which multiple optical encoders can be handled by a single processing circuit; and (4) optical power energy is reduced by utilizing optical pulses. These transducers cover a displacement of 360 deg. with a digital resolution of 12 bits (0.09 deg.).

Author

N92-17917# National Aerospace Lab., Tokyo (Japan). Flight Research Div.

IDENTIFICATION OF THE STABILITY AND CONTROL DERIVATIVES OF A DLC-FLAP SYSTEM FOR VSRA

YUKICHI TSUKANO, TAKATSUGU ONO, and KAZUTOSHI ISHIKAWA 3 Apr. 1991 18 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1116; DE92-526025) Avail: CASI HC A03/MF A01

Flight tests were conducted using the Variable Stability and Response Airplane (VSRA) in order to identify the stability and control derivatives for a Direct Lift Control (DLC) flap system. The frequency response method was selected, with a pure sinusoidal input being applied to the DLC flaps. Response from a linear system model consisting of the stability and control derivatives was compared with other flight test response data to determine general inputs. The resulting derivatives were subsequently verified. Additionally, the control capability of the DLC flaps was estimated by the control derivatives and compared with wind tunnel test data.

Author

N92-25401# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

VIBRATION TESTS AND STRUCTURAL MODELING OF AN AIRCRAFT MODEL FOR ACTIVE CONTROL TECHNOLOGY EXPERIMENTS [ACT JIKKEN YO ZENKI DANSEI MOKEI NO SHINDO SHIKEN TO KOZO MODERU KA]

KENJI FUJII, TETSUHIKO UEDA, and YASUKATSU ANDO Aug. 1990 23 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-626; JTN-92-80313) Avail: CASI HC A03/MF A01

At the National Aerospace Laboratory (NAL), as a part of the research into an ACT (Active Control Technology) for an aerodynamic elastic system, gust load alleviation tests using aircraft elasticity models were performed in a large scale wind tunnel. This report describes the vibration tests of an aircraft elasticity model built for the ACT experiments. The model's main wing was constructed with elastic characteristics that are similar to the actual aircraft. The structural characteristics of the whole model, including the elastic deformation of the main wing, was studied using a mathematical model. The vibration tests were performed to study the structural dynamic characteristics of the model. The mathematical model for the elastic body was constructed using a finite element method based on test results. The control pattern

was designed based on the intrinsic vibration frequencies and elastic deformation.

Author (NASDA)

N92-27956# National Aerospace Lab., Tokyo (Japan). Structural Mechanics Div.

NUMERICAL SIMULATION OF SHOCK-STALL FLUTTER OF AN AIRFOIL USING THE NAVIER-STOKES EQUATIONS

K. ISOGAI In AGARD, Transonic Unsteady Aerodynamics and Aeroelasticity 12 p Mar. 1992

Copyright Avail: CASI HC A03/MF A04

In order to confirm, qualitatively, the unusual flutter phenomenon, which has been observed experimentally for the high aspect ratio (non-tailored) forward swept wing model, as a shock-stall flutter, the aeroelastic response calculation of a two dimensional airfoil whose vibration characteristics are similar to those of the typical section of a forward swept wing, was performed by using the compressible Navier-Stokes equations as a flow solver. By the examination of the flow pattern, pressure distribution and the behavior of the unsteady aerodynamic forces during the diverging oscillation of the airfoil, it is concluded that this is a shock-stall flutter, in which the large scale shock-induced flow separation is playing the dominant role and that there is a mechanism of putting energy into the elastic system of the airfoil, leading to nearly a single degree of freedom flutter.

Author

N92-28154# National Aerospace Lab., Tokyo (Japan). Flight Test Team.

NOTE ON FLIGHT MEASURED CONTROL EFFECTIVENESS OF THE QUIET STOL EXPERIMENTAL AIRCRAFT ASKA

TOSHIO BANDO Apr. 1991 32 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1103; JTN-92-80380) Avail: CASI HC A03/MF A01

An aircraft's control effectiveness can be evaluated in flight tests by applying an exactly known moment to the aircraft. In the NAL Short Take Off and Landing (STOL) aircraft (ASKA), a method was adopted during flight tests to measure control effectiveness of a variable incidence T-tailplane with elevators, ailerons, and spoilers. Known pitching moments were applied by using crew members loaded with ballasts to move from either a forward to rear position or vice versa, whereas known rolling moments were produced by asymmetric fuel loading. Longitudinal spoiler characteristics as a result of spoiler deflections, were investigated by performing alpha sweep tests with a spoiler up-rig. This easy flight test method was used in ASKA's flight tests to evaluate control effectiveness. The flight measured control effectiveness is subsequently compared with wind tunnel test results.

Author (NASDA)

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

A92-12194

PROSPECTS OF TURBULENCE RESEARCH BY MEANS OF TESTING BODIES IN MOTION

MICHIO OHJI, YASUO IKUSHIMA, and WEI-GUO WANG University of Electro-Communications, Bulletin (ISSN 0915-0935), vol. 3, Dec. 1990, p. 277-283. In Japanese. refs

Discussions are presented on the possibilities of measuring turbulent flows on reference frames fixed to moving bodies rather than on laboratory frames. In particular, compact units composed of electronic sensors, amplifiers, A/D converters, CPUs, power supplies and other accessories have been assembled and embedded inside test bodies to measure surface pressure distributions and instantaneous accelerations. This kind of flow

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measurement has been successfully applied to a sphere at free fall and a rotating cylinder in a wind tunnel, showing good prospects in future extension to wider classes of turbulence research.

Author

A92-15328

STUDY ON TRANSONIC CASCADE PERFORMANCE BY USE OF NEWLY BUILT FACILITY

S. KAJI, H. TAKATA, M. HIRAMOTO, Y. MACHIDA, H. FUJITA, and H. ITO (Tokyo, University, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 104-112.

Copyright

A blowdown transonic cascade wind tunnel has been built in the Department of Aeronautics at the University of Tokyo to verify newly introduced concepts, with particular reference to the field of turbomachine cascades. The system and operation of this facility are described in detail, and experimental cascade performances obtained with this facility are discussed together with numerical results for cascades designed on the basis of new concepts.

L.M.

A92-15737

JET ENGINE TEST SYSTEM INCLUDING EXPERT SYSTEM FOR DIAGNOSIS

K. SUZUKI, K. UMENE, and H. ISHIZAWA (Ishikawajima-Harima Heavy Industries Co., Ltd., Mizuho Aero-Engine Works, Tokyo, Japan) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 5 p. (ASME PAPER 91-GT-408)

A jet engine test run system has been developed which enables automatic engine testing (functional and performance checks, including engine control trims). This system includes an expert system for diagnostic procedures which are the result of proper judgments based on experience and knowledge and high speed processing. In this paper, the construction and an application of the jet engine test equipment and the expert system for jet engine diagnostics are described.

Author

A92-22634

FLIGHT SIMULATION AND ITS APPLICATION

KOICHI MATSUSHIMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 586-595. In Japanese. refs

Classifications of flight simulation are outlined. Mathematical and physical models are given, and concepts for the flight simulator and in-flight simulator are discussed. Application of simulation to the Space Shuttle is described.

Y.P.Q.

A92-26975#

EXPERIMENTS TO EVALUATE HOT-JET SIMULATION CAPABILITIES IN CRYOGENIC WIND-TUNNEL TESTING

KEISUKE ASAI and TAKEO AOKI (National Aerospace Laboratory, Tokyo, Japan) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 12 p. refs (AIAA PAPER 92-0567) Copyright

In an attempt to demonstrate hot-jet simulation capabilities in cryogenic wind-tunnel testing, a series of experiments was conducted in the NAL 0.1 m Transonic Cryogenic Wind Tunnel. A cylindrical nozzle-afterbody model with a blunt base was used to evaluate the effects of jet temperature on the base pressure. Tests were carried out at Mach number of 0.8 and at three different stagnation temperatures of 100, 120, and 140 K. Temperature of a nitrogen jet gas was varied from 125 to 420 K to provide jet temperature ratio, values up to 4. The obtained data have verified that the absolute jet temperature is not essential for proper simulation of a hot jet. A comparison of the measured base pressure with hot-jet data by NACA with an ethylene/air combustor in an ambient-temperature tunnel showed a good qualitative agreement.

Author

A92-43096

HYPersonic TESTING TECHNOLOGY OF HOPE (H-II ORBITING PLANE)

NORIO SUZUKI and TETSUICHI ITO (NASDA, Tsukuba Space Center, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 2-5. In Japanese. refs

The requirements on heat-resistant materials in connection with HOPE reentry are presented. The hypersonic test is described and a model test for aerodynamic heating is discussed. The measuring results of the aerodynamic heating distribution are reported, and wind tunnel tests for aerodynamic characteristics are outlined.

Y.P.Q.

A92-43097

TEST ON HIGH ENTHALPY HYPersonic FLOW USING A BALLISTIC RANGE

T. FUJIWARA, AKIHIRO SASO, and XINYU CHANG (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 6-9. In Japanese. refs

A numerical analysis of three-dimensional hypersonic flow is presented. The test equipment for studying high enthalpy hypersonic flow is introduced. The ballistic range measuring sector and the vacuum chamber are emphasized. The thrust velocity measurement is studied.

Y.P.Q.

A92-43098

A TWO-STAGE-DIAPHRAGM FREE-PISTON SHOCK TUBE FOR A STRONG SHOCK WAVE

HIROKI HONMA and HIROYUKI IIZUKA (Chiba University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 10-13. In Japanese. refs

The performance and configurations of a free-piston two-stage-diaphragm shock tube are presented. Piston compression peak pressure and the initial pressure in the high pressure tube are compared.

Y.P.Q.

A92-43099

STUDY ON SMALL STALKER TUBE PERFORMANCE AND NUMERICAL CALCULATION

S. TAKAYAMA, T. OTA, and R. CASEY (Tohoku University, Sendai, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 14-17. In Japanese. refs

The performance and schematic of a stalker tube are presented. The test results show the pressure variations at the compression tube and the pressure distribution in the shock tube. The TVD method is used for the numerical simulation. The maximum pressure of compression in terms of P_c and W_p and isopycnics in the free piston shock wave tube are illustrated.

Y.P.Q.

A92-43104

THERMAL MEASUREMENT TEST IN A SHOCK WIND TUNNEL

Y. HAMADA, T. MATSUDA (Kawasaki Heavy Industries, Ltd., Kobe, Japan), TAKASHI YAMAZAKI, and K. SOGA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 60-63. In Japanese. refs

The National Aerospace Laboratory (NAL) wind tunnel is introduced. A thermal electric sensor is used for measurement of the cylinder model. Test results are given and the aerodynamic heating distribution around the cylinder is emphasized.

Y.P.Q.

A92-43105

RESEARCH ON HYPersonic WIND TUNNEL METHODS IN THE 90'S

SEIICHI HASEGAWA and E. YOSHIOKA (Sumitomo Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 68-71. In Japanese. refs

The facility requirements of thermal wind tunnel tests are

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presented. The viscous interaction efficiency test is addressed. The thermal resistant structural system and structural materials for spacecraft surfaces are discussed. Y.P.Q.

A92-43110

STUDY ON THE LOWER ASPECT VIEW OF A HELICOPTER SIMULATOR

M. UEMURA and M. OI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 88-91. In Japanese.

The display instrument of the simulated visual field for a helicopter is presented. The simulation test of the NOE (nap of the earth) flight course using computer generated imagery is discussed. The display method and the effectiveness of the lower aspect view of a helicopter simulator are addressed. Y.P.Q.

A92-43113

STUDY ON THE EFFECTIVE UTILIZATION OF THE CURRENT FLIGHT SIMULATOR

H. OKU (All Japan Air Transportation, Inc., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 100-103. In Japanese.

Current flight simulator (B767-300) characteristics are introduced, and the simulated visual field instrument is discussed. The eight-channel sound generation system and the SELPAC/MULTISEL computer system are described. Y.P.Q.

A92-43124

DEVELOPMENT OF AN INSTRUMENT FOR MEASURING RUNWAY ROUGHNESS

TOKUO SOTOZAKI and KOSABURO YAMANE (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 144-147. In Japanese. refs

The structure and functions of a runway-roughness measuring instrument are presented. The theory of the optical sensor used and the relationship between the optical sensor and the grooved surface are described. Y.P.Q.

A92-43125

A PROPOSED METHOD FOR EVALUATING RUNWAY ROUGHNESS

TOKUO SOTOZAKI and KOSABURO YAMANE (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 148-151. In Japanese. refs

The evaluation of the roughness of a slippery runway and a method for measuring the average texture depth (ATD) are presented. The roughness of grooved and nongrooved runway surfaces is evaluated. A power spectral density (PSD) method is used to evaluate runway roughness from the standpoint of aircraft loads. Y.P.Q.

A92-43136

TRANSONIC WIND TUNNEL TESTS OF FLUTTER SUPPRESSION EQUIPMENT (WING RESPONSE DATA PROCESSING)

H. MATSUSHITA, K. FUJII, and S. SUZUKI (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 192-195. In Japanese. refs

A wing model designed for vibration tests is described. A transonic wind tunnel test is presented and data analysis for the wing aeroelastic characteristics is considered. An FFT data analysis approach is addressed. Y.P.Q.

A92-43158

A STUDY OF A GROUND SUPPORT EQUIPMENT (GSE) NETWORK

H. INOKA (Japan Airlines, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 292-295. In Japanese.

The aircraft condition monitoring system (ACMS) and the central maintenance computer system (CMCS) are described. The structure of the ACMS and the ground support equipment (GSE) network are discussed. The computer software and hardware for the network system are addressed. Y.P.Q.

A92-43171

RECENT AIRFOIL TESTS IN NAL 2D HIGH REYNOLDS NUMBER WIND TUNNEL

I. KAWAMOTO, H. MIWA, S. BABA, M. SATO, H. KANDA, and N. SUDANI (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 346-349. refs

Experimental results are presented for the NAL's 2D high Reynolds number wind tunnel sidewall boundary layer suction feature. Boundary layer thickness, centerline Mach numbers, and representative airfoil pressure measurements are evaluated. The shock location on the NACA 0012 airfoil at Mach 0.8 and zero incidence is found to exhibit no improvement at full boundary layer suction conditions. Boundary layer thickness is intrinsically large relative to other facilities. O.C.

A92-43199

WING TEST AT THE CRYOGENIC WIND TUNNEL OF THE NATIONAL DEFENSE ACADEMY

YUTAKA YAMAGUCHI, YOSHIHIRO MAN, and Y. NAKAUCHI (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 460-463. In Japanese. refs

Wind test results and NASA 0.3 meter transonic cryogenic tunnel (TCT) data are compared. The test equipment and methodology are discussed. The temperature pattern and R4 airfoil pressure distribution are presented. Y.P.Q.

A92-43210

MOTION ESTIMATION FOR CABLE-MOUNT DYNAMIC WIND-TUNNEL TEST

SHUICHI SASA, MASAOKI YANAGIHARA, TAKASHI SHIMOMURA, MINORU TAKIZAWA, SEIZO SUZUKI, and MASAHIKO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 504-507. refs

Cable-mount dynamic wind-tunnel tests were made in the NAL low speed wind tunnel for estimating longitudinal aerodynamic derivatives of a 5-percent spaceplane model. The longitudinal motion trajectories were estimated by the Kalman filtering technique. The estimates were well consistent with sensor measurements. Stationary and nonstationary Kalman filters were applied, and the applicability of state estimation for real time control was also evaluated. The effectiveness of the system configuration for cable-mount dynamic wind-tunnel test is shown. Author

A92-45422

FUNCTIONAL MOCK-UP TESTS FOR FLIGHT CONTROL SYSTEM OF THE NAL QSTOL RESEARCH AIRCRAFT 'ASKA'

AKIRA TADA, TADAO UCHIDA, TOSHIO OGAWA, NORIYAKI OKADA (National Aerospace Laboratory, Chofu, Japan), ISOROKU UCIKAWA (Kawasaki Heavy Industries, Ltd., Gifu, Japan), HIDEYUKI YAMATO (Tokyo, University, Japan), and YASUO TAKEUCHI (Shinmeiwa Industries Co., Ltd., Hyogo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 525-534. refs
(SAE PAPER 912036) Copyright

Control system functional mockup tests were conducted with

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ASKA, a quiet STOL (QSTOL) aircraft to examine the system's overall control functions using hardware-in-the-loop. Simulation was effectively simplified by omitting the control system right-half side and shortening the system's straight sections. All test measurements were precisely taken, and a 'filtering sampler', an antialiasing technique/device, was designed and employed for digital data acquisition. R.E.P.

A92-47303

STRENGTH EVALUATION AND SAFETY OF MACHINE/STRUCTURE. III - CASE EXAMPLES ON STRENGTH AND SAFETY EVALUATION OF MACHINE/STRUCTURE 3.2 AIRCRAFT (AIRFRAME)

S. MIYAKE Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 777-783. In Japanese. refs

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A92-53564

A PRELIMINARY STUDY OF A SUPERSONIC WIND TUNNEL FOR A RAM JET TEST FACILITY

SHIGERU SATO, TATSUO KUMAGAI, MUNEO IZUMIKAWA, NOBORU SAKURANAKA, and TOHRU MITANI (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 825-830.

Copyright

A Mach-4-class supersonic wind tunnel test facility has been constructed and evaluated in order to obtain data necessary for the design of a supersonic wind tunnel for a ramjet test facility. Details of the experiments are discussed with emphasis on a comparison between a combination of a two-dimensional nozzle and an axisymmetric diffuser and that of an axisymmetric nozzle and a common diffuser. V.L.

A92-54326

PRELIMINARY AIRFOIL TESTING EXPERIENCE IN THE NDA CRYOGENIC WIND TUNNEL

YUTAKA YAMAGUCHI, YASUO NAKAUCHI, MASAHIRO YOROZU, and TERUO SAITO (National Defense Academy, Yokosuka, Japan) IN: ICASF '91 - International Congress on Instrumentation in Aerospace Simulation Facilities, 14th, Rockville, MD, Oct. 27-31, 1991, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 223-230. refs

Copyright

A small two-dimensional high-speed cryogenic wind tunnel was constructed at the Japanese National Defense Academy (NDA) in 1985. The authors describe the present status of the NDA cryogenic wind tunnel and give some preliminary airfoil testing results and experience. Two airfoil models, a NACA 0012 and a R4 airfoil model, were constructed. The R4 test results were compared with those of NASA TM-85739. They were in good agreement in the negative angle of attack range. However, the present R4 model has an extremely small aspect ratio of 0.5 and a high section thickness to tunnel height ratio of about 0.1. Therefore, the present results might be more influenced by the tunnel walls than those of NASA. I.E.

A92-56003

NEW 1.27-M LEG OF THE NATIONAL AEROSPACE LABORATORY HYPERSONIC WIND TUNNEL

S. NOMURA, S. SAKAKIBARA, K. HOZUMI, K. SOGA, N. HIRABAYASHI, T. KOYAMA, and S. TUDA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 12-15. In Japanese.

The current status and design of the National Aerospace Laboratory hypersonic wind tunnel are presented. The working range of the tunnel is discussed and problems such as the heating system are analyzed. Y.P.Q.

A92-56005

MEASUREMENTS OF TURBULENCE IN HYPERSONIC FLOW
Y. AIHARA, T. OKUNUKI, and T. TAMURA (Tokyo, University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 20-23. In Japanese. refs

This paper deals with the measurements of turbulence in super- and hypersonic flow by using multichannels of constant-temperature hot-wire anemometers. Experiments were performed for the hypersonic flow ($M = 7$) at the University of Tokyo, and as to preliminary results, the intensity and spectral distribution of temperature fluctuations were obtained. Author

A92-56011

EVALUATION OF SIDEWALL INTERFERENCE IN THE NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL

NORIKAZU SUDANI, HIROSHI KANDA, and MAMORU SATO (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 44-47. In Japanese. refs

Surface pressure and drag measurements on the NACA 0012 airfoil were conducted in the NAL two-dimensional transonic wind tunnel. Using a comparison with other wind tunnel data, the wall interference effects are discussed, especially those from the sidewall. The results suggest that the Mach number of the actual flow around the airfoil is lower than the setting Mach number. The Mach number correction for the sidewall boundary-layer based on the similarity rule was applied to the present measurements, thereby showing that the shock positions, the pressure distributions and the minimum drag coefficients are in good agreement with both other wind tunnel results and the Navier-Stokes calculation. It is shown that the evaluation indicates satisfactory transonic airfoil test results. Author

A92-56012

ON IMPROVEMENTS OF THREE-DIMENSIONAL POSITION MEASURING SYSTEM FOR DYNAMIC WIND TUNNEL TESTING

OSAMU NONAKA, SEIZO SUZUKI, SHUICHI SASA, MINORU TAKIZAWA, and TAKASHI SIMOMURA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 48-51. In Japanese. refs

This paper describes some factors in relation to the measurement accuracy of the three-dimensional position of the model at the dynamic wind tunnel testing and some improvements of the system tried in order to get more accurate data. As the result of this improvement, it is shown that the measurement accuracy became better by about 50 pct than the previous method. Author

A92-56013

MEASUREMENTS OF LONGITUDINAL STATIC AERODYNAMIC COEFFICIENTS WITH CABLE MOUNT SYSTEM

KATSUICHI MUROTA, MASAOKI YANAGIHARA, and SHIGEO KAYABA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 52-55. In Japanese. refs

Measurements of the longitudinal static aerodynamic coefficients of the 5 pct spaceplane model was performed in the NAL large scale low-speed wind tunnel. The model was supported on the cable mount system whose aerodynamic influence is less than with the strut type. This paper describes a method to measure the trimmed longitudinal aerodynamic coefficients with such a cable mount system and some testing results. Author

A92-56023

MEASUREMENTS OF BLADE FLAPPING MOTION ON A WIND TUNNEL MODEL

NAOHIRO IBOSHI and TOMOARI NAGASHIMA (National Defense

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 92-95. In Japanese.

From the educational viewpoints, the possibility, problems, and accuracy of the wind tunnel test for helicopter models are examined. A commercial radio controlled helicopter is used as the test model with necessary modifications, and measurements of blade flapping motions in forward flight are made. Reasonable results can be obtained. It is ascertained by experiments that the radio controlled helicopter with suitable modifications and installation of detectors is available for an effective apparatus for instruction. Author

A92-56043

AEROTHERMODYNAMIC TEST OF SPACEPLANE BY THIN-SKIN METHOD

YASUTOSHI INOUE, YUKIMITU YAMAMOTO, KOICHI HOZUMI, AKIRA YOSHIZAWA (National Aerospace Laboratory, Chofu, Japan), TADASHI KATSURAHARA, and YOSHIHARU TANAHASHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 186-189. In Japanese. refs

An aerothermodynamic test was conducted on a NAL spaceplane in a hypersonic wind tunnel. High-quality aerothermal distribution data were obtained using a thin-skin-metal model at a freestream Mach number of 7.1. These data showed high heating regions at the body, nose, and wing leading-edges. They also revealed some aerothermal features concerning hypersonic flight such as shock interference and boundary-layer transitions. Author

A92-56076

HELICOPTER ROTOR TESTING USING SCALED MODEL

M. NAKADATE, T. SEKIGUCHI, T. NAGAO, and M. OBUKATA (Fuji Heavy Industries, Ltd., Aerospace Div., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 330-333. In Japanese. refs

Two types of 1/5-scale-model rotors of an intermediate-sized helicopter were tested in hover and forward flight. One was a dynamically scaled model of 'baseline' rotors, while the other was that of 'advanced' rotors. The results showed good agreement between model and full-scale tower test, and the advanced rotor model showed substantially higher performance than the baseline. Author

A92-56111

GROOVED RUNWAY SURFACE TEXTURE BEFORE AND AFTER RUBBER REMOVAL

TOKUO SOTOZAKI and KOSABURO YAMAME (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 498-501. In Japanese. refs

The necessity of the roughness measurement of grooved runway surfaces is addressed. The average texture depth (ATD) of the grooved runway surface is analyzed. Y.P.Q.

A92-56114

AERODYNAMIC MODEL IDENTIFICATION OF A SPACEPLANE MODEL FROM A CABLE-MOUNT DYNAMIC WIND-TUNNEL TEST

M. NAGAYASU, S. SUZUKI, Y. HAYASHI, M. TAKIZAWA, S. SASA, M. YANAGIHARA, T. SHIMOMURA, S. KAYABA, K. MUROTA, and O. NONAKA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 512-515. In Japanese. refs

A cable mount system (CMS) for a dynamic wind tunnel test on a spaceplane model is presented. The parameters of the aerodynamic model are given, and the measurement system is described. Y.P.Q.

A92-56729#

HIGH ENTHALPY WIND TUNNEL FOR EROSION TESTING OF ADVANCED MATERIALS

KIRK HANAWA, Y. TOMIOKA, S. MORIMOTO, M. ISHII, T. FUJIMOTO, and M. MATSUMOTO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 8 p. refs

(AIAA PAPER 92-3888) Copyright

The plasma arc-heated wind tunnel of 20 kW was delivered in late November, 1991, after successful commissioning of various required testings. This tunnel is now owned and operated, as Erosion Testing Machine, by Japan Ultra-High Temperature Materials Research Center (JUTEM) Ltd. in Tajimi, Japan. This apparatus may be utilized mainly for the erosion testing of advanced materials such as composite materials, and function-gradient-material for the future hypersonic aircraft and aerospace planes. Author

A92-56746#

TOHOKU UNIVERSITY LOW-TURBULENCE WIND TUNNEL

Y. KOHAMA, R. KOBAYASHI (Tohoku University, Sendai, Japan), and H. ITO (Nihon University, Koriyama, Japan) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 13 p. refs

(AIAA PAPER 92-3913) Copyright

A general-purpose low turbulence wind tunnel was constructed using the design method of Bradshaw. Sound-absorbent material was used in all four corners to decrease sound intensity produced by a fan. The longitudinal component of turbulence intensity at the center of the closed working section is less than 0.02 pct of the mean velocity in the speed range between 18 m/s and 53 m/s. The mean velocity variations across the working section are within ± 0.1 pct of the mean velocity. Performance measurements have been done at representative tunnel cross sections to clarify the behavior of flow in the tunnel. This work differs from previous studies in the sense that emphasis is placed not only on velocity distributions, but also on turbulence intensity distributions at several cross sections of the tunnel. The critical Reynolds number for a flat plate at zero incidence, measured in a stream of the very low turbulence intensity of 0.016 pct, is larger than that reported by Schubauer and Skramstad. Author

A92-56775#

STUDY ON INTERNATIONAL COOPERATIVE TEST FACILITIES FOR FUTURE SST/HST

HIROTOSHI KUBOTA (Tokyo, University, Japan), TAKEO IWAKI, and TAKASHI TSUJIMOTO (Society of Japanese Aerospace Companies, Inc., Tokyo, Japan) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 7 p. refs (AIAA PAPER 92-3945) Copyright

A plan is set forth for developing the facilities required for testing SST/HST vehicle concepts by envisaging an international collaboration on one large-scale testing infrastructure. The required technologies for next-generation SST/HSTs are examined and shown to include advances in the areas of lift/drag ratio, composite materials, and laminar flow control. The required testing facilities are outlined based on present directions in the areas of CFD technology and specimen loading particularly. The cost and complexity of the facilities to support these areas of research are argued to merit the attention of an international cooperative test facility. Such a facility requires the development of an international consortium of researchers as well as a pilot plant to demonstrate the technological promise in the area of SST/HST. C.C.S.

A92-56815#

A CONCEPTUAL STUDY FOR FUTURE ENGINE TEST FACILITY

Y. FUJITSUNA, A. TANAKA (Ishikawajima-Harima Heavy Industries, Co., Ltd., Tokyo, Japan), K. YOSHIDA (Kawasaki Heavy Industries, Ltd., Kobe, Japan), M. MATSUHAMA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan), and H. KOBAYASHI (Fuji Heavy Industries,

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Ltd. Utsunomiya, Japan) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 11 p. refs (AIAA PAPER 92-3992) Copyright

Results of a 2-year feasibility study concerned with the development of a future high-altitude test facility for hypersonic transport (HST) engine development are reported. The discussion covers HST engine performance characteristics, test requirements, relevant technology, and evolution of the test facility functions. The planned facility will cover the HST flight envelope (Mach 5, altitude 35 km) and provide the capabilities of both direct connect and freejet tests. V.L.

A92-56838#

NUMERICAL PREDICTION OF THE FLOW CHARACTERISTICS IN AN ARC WIND TUNNEL

M. MITSUDA, T. KUROSAKA, Y. SAKAMOTO (Kobe Steel, Ltd., Mechanical Engineering Research Laboratories, Japan), T. WASHIDA, and T. ARAI (Kobe Steel, Ltd., Engineering and Machinery Div., Takasago, Japan) AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992. 17 p. refs

(AIAA PAPER 92-4016) Copyright

Four kinds of numerical prediction were performed to examine the characteristics of the arc-wind tunnel flowfield. The flowfield in the constricted arc heater was calculated by solving the Navier-Stokes equation with the Joule heat source. Flow uniformity can be obtained in a longer arc heater. The flow in the throat region was computed by solving the quasi-1D Euler equation with chemical nonequilibrium reaction, and the flow is nearly frozen. The flowfield calculation in the conical nozzle under the assumption of the perfect gas of the ratio of specific heats of 1.4 agree with the experimental data, and the disturbance of the Mach number/pitot pressure at the nozzle exit is about 6 percent. With increase in the flat-plate inclination angle, the pressure and the heat flux increase simultaneously. Author

N92-13076# General Accounting Office, Washington, DC.

AEROSPACE TECHNOLOGY: TECHNICAL DATA AND INFORMATION ON FOREIGN TEST FACILITIES

Jun. 1990 584 p

(GAO/NSIAD-90-71FS; B-235387) PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies \$2.00

This report provides data and information collected by the General Accounting Office (GAO) on foreign government and industry investment in aerospace vehicle research and technological development efforts. The focus is on those critical or enabling technologies that could allow foreign countries to develop and build future aerospace vehicles. The report also identifies indicators for measuring foreign countries' current state of aerospace vehicle technological development and progress. The review includes France, West Germany, the United Kingdom, and Japan, since each of these countries are developing technologies for various concepts of operational aerospace vehicles to secure independent access to space and reduce the costs of launching payloads into orbit. Also included are facilities, such as wind tunnels, in The Netherlands, Belgium, Italy, and Australia because their test facilities are being used to conduct research and development of air-breathing aerospace vehicles by other countries and the European Space Agency (ESA). Information was collected on test facilities, their capabilities, and the number of people working on aerospace vehicle research and development in the countries that were included in the review. Facilities include (1) wind tunnels and shock tunnels, (2) air-breathing propulsion test cells (engine test facilities for ramjets and scramjets), (3) aerothermal test facilities, (4) aeroballistic and impact ranges, (5) advanced materials research, development, production, and fabrication laboratories, and (6) aerodynamic computation facilities (supercomputers). Cost information collected on test facilities included construction, replacement, annual operating, and, where available, user costs. J.P.S.

N92-17756# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

IMPROVEMENT OF DATA PROCESSING SYSTEM FOR GUST WIND TUNNEL DATA ACQUISITION PART: SYSTEM CONVERSION FROM OFF-LINE TO ON-LINE PROCESSING [TOPPU FUDO DETA SHORI SOCHI (DETA SHUSHUBU) NO KAISHU: KEISOKU SHISUTEMU NO ONRAINKA]

TOSHIMI FUJITA, AKIHITO IWASAKI, and HIROTOSHI FUJIEDA Jul. 1989 60 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-611; JTN-92-80247) Avail: CASI HC A04/MF A01

The data acquisition part of the gust wind tunnel in National Aerospace Laboratory has been changed from the OKITAC-4300 off-line processing system to the ECLIPSE MV/7800 XP on-line processing system. At the same time, the primary data processing system has been updated with quick look display to conduct wind tunnel tests more efficiently. The new system enables the great improvement of wind tunnel test efficiency and data productivity as follows: (1) human operation errors in the wind tunnel test can be prevented; (2) repetition of the same test caused by inferior or abnormal data can be avoided; and (3) turn around time from data acquisition until data processing can be cut down from a day or hourly time scale to minutes or seconds.

Author (NASDA)

N92-18037# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.

ULTRA HIGH SPEED NUMERICAL WIND TUNNEL (UHSNWT) INITIATIVE AT NATIONAL AEROSPACE LABORATORY NUMERICAL SIMULATOR - SECOND GENERATION

HAJIME MIYOSHI May 1991 31 p In JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1108) Avail: CASI HC A03/MF A01

In order to promote computational fluid dynamics (CFD) research activities and effectively apply their results in the research and development of future aircraft and space planes, it is necessary to develop within the next two or three years a CFD-oriented computer (ultra high-speed numerical wind tunnel/UHSNWT) whose CFD processing speed is more than 100 times higher than the currently used Fujitsu VP400, and also to subsequently develop a computer more than 1000 times faster by the end of 1990's. The requirements for the UHSNWT are discussed from a perspective of development and operation costs, reliability, affinity with CFD programs, and operation environment. In addition, a National Aerospace Laboratory (NAL) UHSNWT initiative is proposed based on the following: (1) vector computer operational; (2) program processing software simulation for several vector computer configurations; and (3) future trend forecasts of Large-Scale Integrated Circuit (LSI) technology. It is concluded that developing the UHSNWT with a performance of more than 100 times higher than the VP400 is feasible using a parallel computer having a distributed memory and crossbar network.

Author

N92-23778# National Aerospace Lab., Tokyo (Japan). Aerodynamics Div.

DEVELOPMENT OF WALL PRESSURE MEASURING APPARATUS FOR AN EXISTING TRANSONIC WIND TUNNEL TEST SECTION

SEIZO SAKAKIBARA, HIDEO SAWADA, KOICHI SUZUKI, SEIGO NAKAMURA, and NOBUYUKI HOSOE Mar. 1987 29 p In JAPANESE; ENGLISH summary (ISSN 0452-2982)

(NAL-TM-565; JTN-92-80309) Avail: CASI HC A03/MF A01

An apparatus for measuring ventilated wall pressure distributions in the NAL 2 m x 2 m transonic wind tunnel was developed. Described in this paper is the necessity for transonic wind tunnel test section pressure distribution data. Secondly, the construction and function of each component of the apparatus, which were designed for the transonic wind tunnel without altering the existing wall configurations, are described. Finally, typical examples of

pressure distribution data obtained with this apparatus are shown. The results of detailed analysis of this pressure distribution data will be separately reported. Author (NASDA)

N92-23979# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

DISTRIBUTED COMPUTER SYSTEM IN THE LARGE SCALE LOW SPEED WIND TUNNEL [OGATA TEISOKU FUDO NI OKERU BUNSAN SHORI SHISUTEMU NI TSUITE]

HIDEO HOSHINO, KATSUICHI MUROTA, and HIROFUMI KONDO Nov. 1990 34 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-629; JTN-92-80327) Avail: CASI HC A03/MF A01

In 1987 the static quantity instrumentation equipment of the large wind tunnel in the NAL was replaced. In the new equipment the number of measurement channels was increased and test results monitoring functions and data gathering functions were distributed. The measurements and monitoring of air flow parameters such as flow rate, dynamics pressure, static pressure and angle of attack in model settings and data gathering are automated with the use of FA (Factory Automation) computer system. Simple calculations of test results, such as averaging, were made possible in the new equipment. The host computer in the old system was improved to transmit and record data in disk file according to the predetermined formats and to calculate the air flow coefficients and graphic data. Main configurations and functions of the new distributed system were described. As for the host computer system, data transmission function which transmits observed data to the distributed system and data display functions of the transmitted data were described.

Author (NASDA)

N92-25365# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

STUDY OF THE NAL'S 0.1 X 0.1 M MAGNETIC SUSPENSION AND BALANCE SYSTEM [0.1 METORU KAKERU 0.1 METORU JIRYOKU SHIJI SOCHI NO SHISAKU]

HIDEO SAWADA, HIROSHI KANDA, and HISASHI SUENAGA Jun. 1990 20 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-623; JTN-92-80311) Avail: CASI HC A03/MF A01

For wind tunnel tests where the model is supported inside the measuring unit, the support has to be constructed so that it will not disturb the flow field around the model. A magnetic suspension and balance system for a model was devised, as considerations on the interference from the support was not necessary. The magnetic support does not require any member inside the measuring unit and the air flow behind the model is not disturbed. First, basic structure and a brief history of the magnetic suspension and balance system is described. Then the actual design method of the 0.1 x 0.1 m magnetic suspension and balance system developed at NAL is presented. From test results of this system, the magnetic suspension and balance system circuit, power supply capacity, winding turns of the coil, and model location and inclination measuring sensor proved to be satisfactory. The improvement of measuring accuracy and control ability for the direction of y-axis and psi-axis are needed. Author (NASDA)

N92-25402# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

THE FIBRE OPTIC THREE DIMENSIONAL LASER TWO FOCUS VELOCIMETER FOR THE LOW-SPEED WINDTUNNEL. PART 1: TWO-DIMENSIONAL MEASUREMENT EVALUATIONS

SHOHEI TAKAGI, KATSUICHI MUROTA, NAOAKI KUWANO, and SHIGEO KAYABA Sep. 1990 33 p In JAPANESE; ENGLISH summary (ISSN 0452-2982)

(NAL-TM-627; JTN-92-80314) Avail: CASI HC A03/MF A01

A fiber optic three dimensional Laser Two Focus (L2F) Velocimeter was introduced in the Aircraft Aerodynamics Div. in 1988. The former half of the present report describes both an outline and the principle of this system for two dimensional measurements. In the latter half, the L2F Velocimeter is evaluated

by using three types of flows, i.e., two dimensional wake, three dimensional boundary layer, and quasi two dimensional free jet with, and occasionally without, seeding particles. Furthermore, several seeding particles such as paraffine vapor, mosquito repellent smoke, and tobacco smoke are used for evaluations. The axial velocity component from the L2F Velocimeter is pointwisely compared with a calibrated velocity. The comparison is extended to the transverse mean velocity component and fluctuating components with hot-wire measurements, in which great care was taken with the linearity and wire inclination. There is no incongruity in comparison except in low turbulence with less than two percent intensity to the local velocity. In summary, features of the fiber optic L2F Velocimeter are its applicability to natural seed, wall proximity, and noncalibration measurements, although it is apriori known that the L2F Velocimeter is not adaptable to both reverse flow and high turbulence measurements.

Author (NASDA)

N92-27428# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

A PRESSURE MEASUREMENT METHOD USING ELECTRONICALLY SCANNER PRESSURE SENSORS (ESP) INSTALLED IN A GUST WIND TUNNEL

TOSHIMI FUJITA, AKIHITO IWASAKI, FUMIKO ITOU, and HIROTOSHI FUJIEDA Jul. 1991 27 p In JAPANESE; ENGLISH summary (ISSN 0452-2982)

(NAL-TM-638; JTN-92-80364) Avail: CASI HC A03/MF A01

Electronically Scanner Pressure (ESP) sensors were installed at various data acquisition locations in a Gust Wind Tunnel in order to obtain pressure measurements at high speeds. However, changes in the environmental conditions, particularly flow temperature, resulted in the sensors displaying a span and zero shift, thus making them difficult to use in a long run wind tunnel tests. Experiments were subsequently performed to solve these problems, and a method was established which assured they maintain their required measurement accuracy. This method utilized the established ESP sensors system and efficiently reduced data acquisition requirements. In the case of a Short Take Off and Landing (STOL) aircraft semispan model, the time required for wake measurements was reduced by approximately equals 2 percent, i.e., the test took only one hour versus one and a half days using the previous method. Both the newly developed method and the currently used high speed pressure measuring system using ESP sensors are described. Author (NASDA)

N92-28829# National Aerospace Lab., Tokyo (Japan). Aeroengine Div.

AIR EJECTOR EXPERIMENTS USING THE TWO-DIMENSIONAL SUPERSONIC CASCADE TUNNEL: ZERO SECONDARY FLOW PERFORMANCE Report No. 1

SUSUMU TAKAMORI and HAJIME SAKAGUCHI Feb. 1991 19 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-632; JTN-92-80350) Avail: CASI HC A03/MF A01

The air ejector has almost limitless application possibilities in engineering practice due to its simplicity. To determine the feasibility of using an ejector as a suction pump for boundary layer air removal in the two dimensional supersonic cascade tunnel, especially when a portion of the tunnel's air supply is used for its primary flow, both subsonic and supersonic air ejector tests were conducted. The tested ejector was axially symmetrical and a center jet type, with its geometrical configuration being varied, i.e., the primary nozzle to mixing tube throat area ratio, and the straight mixing space (mixing tube) and diverging passage section (diffuser) lengths. These configuration changes enabled geometrical effects on ejector performance to be obtained. The following experimental results using a zero secondary flow air ejector are discussed: (1) the effects of the straight mixing and diverging passage section lengths on the relationship between secondary pressure (secondary vacuum chamber pressure) and primary stagnation pressure (primary pressure characteristics) during a zero secondary flow condition; (2) the effect of throat area ratio of primary nozzle to

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mixing tube on primary pressure characteristics; (3) the relationship between the minimum secondary pressure and throat area ratio; (4) the optimal operating conditions for a zero secondary flow subsonic ejector; and (5) the effect of primary Mach numbers on a zero secondary flow supersonic ejector performance.

Author (NASDA)

N92-28833# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

UPGRADING THE DATA PROCESSING SECTION OF THE NAL GUST WIND TUNNEL DATA PROCESSING SYSTEM

AKIHITO IWASAKI, TOSHIMI FUJITA, and HIROTOSHI FUJIEDA
May 1991 22 p In JAPANESE

(ISSN 0452-2982)

(NAL-TM-635; JTN-92-80352) Avail: CASI HC A03/MF A01

The data processing system in NAL Gust Wind Tunnel is composed of data acquisition and data processing sections. The outline of the system used to upgrade the data processing section and secondary data processing for wind tunnel data are described. The new system includes an Eclipse MV/7800XP CPU, six megabytes of memory, and various peripheral devices. Performance enhancements were obtained using this upgrade.

Author (NASDA)

N92-28835# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

REPLACEMENT OF THE NAL HIGH PRESSURE AIR STORAGE SYSTEM

SHIGEO BABA, HISASHI SUENAGA, MASAMITU SUZUKI, and NOBUHIRO TODA
Mar. 1991 31 p In JAPANESE

(ISSN 0452-2982)

(NAL-TM-634; JTN-92-80362) Avail: CASI HC A03/MF A01

The replacement process is described for the high pressure air storage vessel attached to the 2 m x 2 m Transonic Wind Tunnel of the NAL. The oldest two of three existing 10 m diameter vessel were dismantled and replaced by a new 13 m diameter vessel, thereby preserving the total capacity. Both the operational and maintenance histories of the old vessel are discussed, as well as the design construction features included in the new one, its initial test results, and the important issues related to future system operations.

Author (NASDA)

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ASTRONAUTICS (GENERAL)

A92-11003#

VENUS BALLOONS AT LOW ALTITUDES

J. NISHIMURA, M. HINADA, N. YAJIMA, and M. FUJII (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 12-19. refs (AIAA PAPER 91-3654) Copyright

A spherical balloon made of thin Ti alloy, or reinforced by CFRP, and pressurized by He is proposed to study the detail of the Venus atmosphere. Attention is given to the necessity of using high-temperature electronics to operate in the Venus atmosphere in temperatures as high as 300 C to 400 C at altitudes of 10 km to 20 km. Consideration is given to the weight constraint of the balloon system including the weight of the support structure in the spacecraft to support the balloon, a gas container and a decelerator system.

R.E.P.

A92-11879

RETURN TO THE MOON?

DARREN BURNHAM Spaceflight (ISSN 0038-6340), vol. 33,

Nov. 1991, p. 370-376. refs

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A report is presented of the general hiatus that has occurred regarding lunar explorations with the singular exception of Japan's Space Engineering Satellite by MU rocket (MUSES-A). Specific objectives of MUSES-A included a series of repeated earth and lunar flyby's (preparing for the forthcoming Geotail ISTP mission), the deployment of a small subsatellite in lunar orbit, and extensive flight tests of newly developed computer and optical navigation subsystems. An advanced Lunar-A orbiter will have as its main objective the deployment of penetrator probes for direct surface investigation. Attention is given to NASA's Lunar Polar Orbiter, Lunar Observer Project, and Lunar Scout programs.

R.E.P.

A92-12435

EXPRESS - A NEW RE-ENTRY TECHNOLOGY CARRIER

INGO RETAT and JOACHIM THAETER (MBB-ERNO, Bremen, Federal Republic of Germany) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 5 p. refs (IAF PAPER 91-010) Copyright

A reusable blunted-cone-type reentry vehicle is described in terms of developmental status, features of the design, and projected capabilities. The baseline carrier of the Express reentry vehicle allows the 165-kg maximum payload to interface with the structure, thermal control, data management, and telemetry subsystems of the vehicle. The structure is essentially aluminum, and a passive thermal-control system is incorporated to protect vehicle and payload. Descriptions of other Express systems are given including the battery power supply, attitude control, the retroboost motor, and the telemetry/telecommand system. The first mission is planned to include a 5-day elliptical orbit in which the Express is activated following the launcher's fourth stage and carries a microgravity materials experiment. The Express reentry vehicle is designed for a 5-mission life with existing reusable hardware, a modular payload system, access to user mission data, and short turn-around time.

C.C.S.

A92-12478

THE JAPANESE EXPERIMENT MODULE FOR SPACE STATION FREEDOM

K. IDA (Science and Technology Agency, Tokyo, Japan), H. MURAYAMA, and Y. HORIKAWA (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 6 p.

(IAF PAPER 91-066) Copyright

The development of the Japanese Experiment Module (JEM) is examined with specific reference to proposed areas of investigation and their corresponding levels of preparation. The organization of the Space Station program in Japan is described to establish the financial and philosophical context of the JEM. JEM is developed according to operational requirements with the User Support Center which encompasses payload integration, training and logistics support facilities, and an information network system. The Space Station Integration and Promotion Center supports the activities for both JEM and Space-Station preparation. The utilization of JEM is proposed for observational, technological, and life science applications of interest to the general scientific community. The restructuring of the international Space Station project is concluded to have a significant impact on the development and scope of JEM.

C.C.S.

A92-12500

STATUS OF JAPANESE EXPERIMENT MODULE OPERATIONS PROJECT

HIDESHII KOZAWA, YOSHIYUKI HASEGAWA, SHOJI MATSUBARA, and TORU OHUE (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p.

(IAF PAPER 91-094) Copyright

The development of the Japanese Experiment Module (JEM) is described with attention given to the operational systems, structures, and status. The 2D-matrix Work Breakdown Structure (WBS) is introduced to analyze the operations of the JEM and

improve the efficiency of operational management. The 2D WBS comprises a WBS based on JEM operations system functions and a work-type WBS; functions of the major systems are listed, and reports are given on the major topics of JEM operations project. Issues of operational systems addressed include engineering support, logistics support, launch-site planning, and the crew-training system. The computer algorithm for JEM operations is introduced, and work is discussed for weightlessness training and facilities development. It is concluded that multilateral operations concepts are important for efficient development and use of module and space-station concepts. C.C.S.

A92-12530

OVERVIEW OF JERS-1 OPERATION PLAN

T. KOIZUMI, C. ISHIDA (NASDA, Earth Observation Satellite Group, Tokyo, Japan), S. KAWASE, T. NAGAI (NASDA, Earth Observation Center, Hatoyama, Japan), K. YAMAYA, and K. TANAKA (NASDA, Tsukuba Space Center, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs (IAF PAPER 91-135) Copyright

The Japanese Earth Resources Satellite-1 (JERS-1) mission (scheduled for launch in February 1992) is described, with particular attention given to the mission profile, the satellite's operational capabilities and constraints, the ground segment, and the mission planning procedures. JERS-1 will carry a SAR, an Optical Sensor system consisting of two separate radiometers (a visible and NIR radiometer and a short-wavelength IR radiometer), a data transmitter, and a data recorder. The satellite is currently undergoing a system check-out. The designed mission life is 2 years. I.S.

A92-12536

STATUS OF ADEOS MISSION SENSORS

NOBUO IWASAKI, MAKOTO KAJII, YOSIO TANGE, YUJI MIYACHI, TOSHIHARU TANAKA, RYOTA SATO, and KOUICHI INOUE (NASDA, Earth Observation Satellite Group, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. (IAF PAPER 91-144) Copyright

The paper describes the sensors designed for the Advanced Earth Observation Satellite (ADEOS) mission and discusses their status from the viewpoint of the interface coordination. These sensors include the Advanced Visible and Near-Infrared Radiometer (AVNIR), the Ocean Color and Temperature Scanner (OCTS), and six Announcement of Opportunity sensors. Attention is also given to the ADEOS satellite concept, the ADEOS mission operation, and the mission sensor interface. Schematic and configuration diagrams of OCTS and AVNIR are presented along with a diagram of the on-orbit configuration of ADEOS. I.S.

A92-12553

THE DEVELOPMENT STATUS OF OREX (ORBITAL RE-ENTRY EXPERIMENT) PROJECT IN JAPAN

TATSUSHI IZUMI, ISAO KAWANO, TOMOYUKI KOBAYASHI, HIROSHI SASAKI, MOTOYUKI INABA, TOSHIO AKIMOTO (NASDA, Tsukuba Space Center, Japan), and YASUTOSHI INOUE (National Aerospace Laboratory, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs (IAF PAPER 91-174) Copyright

The National Space Development Agency of Japan (NASDA) is presently studying the H-II Orbiting Plane (HOPE). HOPE is a space vehicle planned to be launched by the H-II rocket, to transport logistics to the international Space Station FREEDOM/JEM and to return back to the earth. NASDA is now planning the Orbital Reentry Experiment (OREX) to acquire engineering data for HOPE. The missions of OREX are acquisitions of aerodynamic data during entry period, thermal data on thermal protection system (TPS), data concerning communication blackout, and GPS experiment data for HOPE. Carbon/carbon material and ceramic tiles are adopted as TPS in order to measure the aerodynamic heating of TPS for HOPE and to test it. The blunt

cone shape is selected to make aerodynamic heating rate at nose same as that of HOPE. The configuration of guidance and control system is based on that of NASDA launch vehicle. Author

A92-15255

DYNAMIC SIMULATION OF STRUCTURE DESTRUCTION PROCESS CAUSED BY SPACE DEBRIS COLLISION

YOSHIKI OHKAMI and OSAMU OKAMOTO (National Aerospace Laboratory, Chofu, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs (IAF PAPER 91-340) Copyright

This paper deals with a digital simulation of a collision process of a ball with a plate from dynamical point of view, for the prediction of the structural damage and debris dispersion. A flat plate structure is modeled as a collection of rigid bodies connected by nonlinear springs which possess the material deformation characteristics. The collision process is modeled as repulsive force of a connecting hinge which changes from a free condition (pre-collision phase) to a kinetic constraint with a extremely hard spring and a certain amount of damping. After a possible passage of a kinetic constraint, the debris may penetrate through the plate or may be reflected. This scheme has turned out useful in debris collision simulation, which in some cases the collision can produce pieces of debris, and their trajectories and attitudes are precisely predicted. Illustrative examples are given which clearly show the destruction process and structural damage of the space structure as well as the secondary debris dispersion trajectories. Author

A92-17325

TIDES IN A SPACE COLONY

JUN FUKUE (Osaka Kyoiku University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 657-660. refs Copyright

The tides of a cylindrical ocean in a space colony are examined. When the rotation axis of the colony is perpendicular to the direction of the earth, the shape of the cylindrical ocean becomes an ellipse whose major axis is perpendicular to the direction of the earth. On the other hand, in the case of tides in an ocean of the earth, the major axis is parallel to the direction of the moon. In both cases, however, a full tide takes place at a point under the body which exerts the tidal force. Author

A92-17802#

'SPACEPLANES' R&D STATUS OF JAPAN

TATSUO YAMANAKA (National Aerospace Laboratory, Chofu, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 12 p. refs (AIAA PAPER 91-5002) Copyright

Activities related to the development of aerospace planes are discussed with attention given to basic problems and requirements facing the fledgling industry. Among the programs in progress discussed are the Highly Maneuverable Experimental Space (Himes) vehicle, the Orbital Reentry Experiment (OREX), the Japanese Experimental Module (JEM), and the Advanced Technology for Aerospace Study (ATAS) program. The H-2 Orbiting Plane (HOPE) is also described in terms of conceptual and aerodynamic studies as well as structural and avionic considerations for a 20-ton HOPE vehicle. Test facilities and programs for SSTO and TSTO engine concepts are discussed in the light of studying aerospace-planes' systems. Specifications are given for five engines - two are rocket-mode engines - that correspond to specific mission requirements. C.C.S.

A92-17853#

SPACE ACTIVITIES IN THE 21ST CENTURY - EXPECTATION FOR SPACEPLANE

Y. OHKAMI (Tokyo Institute of Technology, Japan), T. YAMANAKA, and M. MAITA (National Aerospace Laboratory, Tokyo, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 6 p. refs (AIAA PAPER 91-5085) Copyright

This paper presents a heavy traffic mission model for space

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transportation in the 21st century. The model includes three major missions: extensive in-orbit experiments of microgravity, utilization of solar power, and human mass transportation. For the realization of these activities, it is shown that a reusable spaceplane is necessary and that the development of such vehicles can be justified. Three different types of spaceplanes are investigated: two types are all rocket-powered SSTO with and without wings, and the third is a scram-jet powered SSTO. The feasibility of each type is discussed in terms of delta-V capability and fuel mass fraction in addition to the mission compatibility. Author

A92-18489

A MARS MISSION IN SPACE PLASMA PHYSICS

JUN'ICHIRO KAWAGUCHI, KOUICHIRO TSURUDA, TOSHINORI MUKAI, and ICHIRO NAKATANI (Institute of Space and Astronautical Science, Sagamihara, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs

(IAF PAPER 91-466) Copyright

Both the spacecraft design and mission outline of the proposed Martian mission are set forth in which the focus is the extended study of plasma physics. The orbiter is planned to be put into operation by the M-V primary launcher, and the investigation is intended to emphasize the interaction between solar wind and the Martian upper atmosphere. The Planet-B spacecraft is designed to carry a 40-kg scientific payload including a magnetometer, plasma sensor, neutral particles detector, and imagers. C.C.S.

A92-18521

REPORT ON SSU, U3P AND FOUNDATION SOLAR SAIL ACTIVITIES FOR THE EARTH-MOON RACE

KORYO MIURA (Solar Sail Union, Sagamihara, Japan), JEAN-YVES PRADO (Union pour la Promotion de la Propulsion Photonique, Toulouse, France), and ROBERT L. STAEHLE (World Space Foundation, Pasadena, CA) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs

(IAF PAPER 91-513) Copyright

The activities of the participants in the Earth-moon Race are described, and details are given on the nature and requirements of the race. The three competitors are developing solar-sail crafts for placement in geostationary orbit, and the winner is the first spacecraft to transmit images of the moon's hidden face. The details of the race include definitions of terms such as the 'domain of concern' and the parameters of the orbits and the trajectory. An international jury is required to monitor the competition, and propulsion, finish, and achievement rules are explained. The Traveling Navigation Center is in development for the U3P (European) team and is expected to provide data on the trajectory and maneuvers of the U3P spacecraft. NASA's World Space Foundation is intended to carry a 'SpaceArc' payload to disseminate digital data for educational settings. C.C.S.

A92-18580

BREAKUP IN GEOSTATIONARY ORBIT - A POSSIBLE CREATION OF A DEBRIS RING

TETSUO YASAKA (NTT, Radio Communication Systems Laboratory, Yokosuka, Japan) and NOBUAKI ISHII (Institute of Space and Astronautical Science, Sagamihara, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 13 p. refs

(IAF PAPER 91-596) Copyright

The possibilities and ramifications of the generation of a debris ring are analyzed with a dynamic model of the geostationary ring. The model incorporates the momentum, energy, and velocity relationships of collisions between objects and the resulting fragment clouds. The equations are considered in the light of collision probabilities of geosynchronous satellites, and debris-cloud evolution is illustrated. Consideration is given to the effects of solar radiation pressure and corridor-passage time, and collision rates are computed with a numerical simulation. Debris in the geostationary region remain near the region but are evenly distributed after a few weeks, and all debris fragments are equally hazardous to operating satellites. Fragments from collisions or

explosions in the geosynchronous region can cover the entire arc after a period of cascading, and preventive measures are needed to protect the geostationary region. C.C.S.

A92-18652

COLLISIONS IN SPACE - A RETROSPECTIVE OVERVIEW OF ISAS STUDIES

K. UESUGI (Institute of Space and Astronautical Science, Sagamihara, Japan) (Space dust and debris; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission B /Meetings B2, B3, and B5/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-18651 05-12) Advances in Space Research (ISSN 0273-1177), vol. 11, no. 12, 1991, p. 19-27. refs

Copyright

A chronological review of studies in ISAS concerning collisions in space is presented. The collision probability in space with artificial orbiting bodies was estimated, and a Space Traffic Control System was proposed, in 1971. The design of a space station for safety against collision hazards was discussed in 1972. A trajectory optimization technique for low-thrust multiple rendezvous mission in order to sweep space debris around the earth was developed in 1977. In 1984, the collision probability was reestimated using space debris data accumulated for more than a decade. Several experimental projects in ISAS, such as hypervelocity impact experiments using a railgun system, sampling and measuring of alumina particles in exhaust plume of solid-propellant rocket motors, and a result of analysis on the behavior of such alumina particles in orbit are also introduced. Author

A92-19426* Tokyo Univ., Sagamihara (Japan).

THE SOLAR-A MISSION - AN OVERVIEW

Y. OGAWARA, T. TAKANO, T. KATO (Institute of Space and Astronautical Science, Sagamihara, Japan), T. KOSUGI, S. TSUNETO (Tokyo, University, Mitaka, Japan), T. WATANABE (National Astronomical Observatory, Mitaka, Japan), I. KONDO (Shibaura Institute of Technology, Omiya, Japan), and Y. UCHIDA (Tokyo, University, Japan) Solar Physics (ISSN 0038-0938), vol. 136, Nov. 1991, p. 1-16. Research supported by NASA and SERC. refs

Copyright

An overview of the Solar-A spacecraft, launched in August 1991, is presented. This mission is dedicated primarily to the study of solar flares, especially of high-energy phenomena observed in the X- and gamma-ray ranges. With a coordinated set of instruments, including hard X-ray and soft X-ray imaging telescopes as well as spectrometers with advanced capabilities, it is expected to reveal many new aspects of flares and help better understand their physics, supporting international collaboration with ground-based observatories as well as theoretical investigations. The scientific instruments of Solar-A, especially the soft X-ray telescope, require sophisticated control of flight operations to exploit their capabilities with the constraints of the telemetry data rate and the capacity of the data recorder; this is achieved by the 'data processor' unit. Objectives include flare-related phenomena, dynamical phenomena not necessarily related to flares, and global coronal structure. P.D.

A92-22630

A CONCEPTUAL STUDY OF HOPE

TETUJI NARASAKI and HIROSHI MIYABA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 560-564. In Japanese.

NASDA research and development on HOPE (H-II Orbiting Plane) is reviewed. Plans for the recovery of the Japanese experiment module of Space Station Freedom are discussed.

Y.P.Q.

A92-23653* National Aeronautics and Space Administration, Washington, DC.

I-SAIRAS '90; PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON ARTIFICIAL INTELLIGENCE, ROBOTICS AND AUTOMATION IN SPACE, KOBE, JAPAN, NOV. 18-20, 1990

Symposium sponsored by AIAA, American Association of Artificial Intelligence, NASA, et al. Tokyo, REN Associates, Inc., 1990, 352 p. For individual items see A92-23654 to A92-23729.

The present conference on artificial intelligence (AI), robotics, and automation in space encompasses robot systems, lunar and planetary robots, advanced processing, expert systems, knowledge bases, issues of operation and management, manipulator control, and on-orbit service. Specific issues addressed include fundamental research in AI at NASA, the FTS dexterous telerobot, a target-capture experiment by a free-flying robot, the NASA Planetary Rover Program, the Katydid system for compiling KEE applications to Ada, and speech recognition for robots. Also addressed are a knowledge base for real-time diagnosis, a pilot-in-the-loop simulation of an orbital docking maneuver, intelligent perturbation algorithms for space scheduling optimization, a fuzzy control method for a space manipulator system, hyperredundant manipulator applications, robotic servicing of EOS instruments, and a summary of astronaut inputs on automation and robotics for the Space Station Freedom. C.C.S.

A92-23677

ADVANCED SPACE TELEROBOTICS - CONCEPT AND APPLICATIONS

MASATOSHI ONO, KAZUO MACHIDA (Electrotechnical Laboratory, Tsukuba, Japan), and HIROYUKI NAGAYAMA (Mitsubishi Research Institute, Inc., Tokyo, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 109-112. refs

The concept of an advanced telerobot, which is an extra-vehicular flying telerobot for maintaining space facilities, is considered. The main technological targets for the robot are high autonomy, flexible operation and space fly/walk capabilities. For the application of this robot, the concept of space maintenance facility which maintains geostationary satellites periodically is proposed. R&D plans utilizing ground testbeds and test flights using the Japanese Experiment Module of Space Station Freedom are also discussed. Author

A92-23722

DESIGN STUDY OF ROBOTIC SYSTEM FOR SPACE FACTORY

TAKEYA KAWAMURA, MICHIAKI MIZUOCHI, and YUKIO TANAKA (Mitsubishi Heavy Industries, Ltd., Kobe Shipyard and Machinery Works, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 317-320.

A conceptual design is proposed for a space-based automated factory in a pressurized module dedicated to aerospace industrial activities. The robotic system is made up of a mobile system, both heavy-duty and dexterous dual-arm manipulators, and a camera arm for monitoring. The conceptual design is based on transfer tasks requiring a mobile system as well as tasks that involve objects of a large range of sizes. The final conceptual design incorporates five manipulator arms and the mobile system which allow dual-arm operations, operation inside equipment, collision avoidance, and transfer to the outside of the space module. Specific areas which require further investigation remain including the development of special tools, optimizing the manipulator-arm arrangement to permit the use of a shorter arm, and maximizing collision avoidance through the development of redundant-manipulator control theory. C.C.S.

A92-23724

ON ORBIT SERVICING AND ITS IMPLICATIONS ON FUTURE GEOSTATIONARY ACTIVITY GROWTH

TETSUO YASAKA, YOSHITSUGU YASUI, and SHUN-ICHI ODA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 325-328. refs

The on-orbit servicing of geostationary satellites is considered in terms of cost efficiency, the minimization of environmental change, and the utilization of material resources. The concept of the Geostationary Service Vehicle is presented with attention given to its inapplicability to spent satellites and parts left in GEO. In order to determine the requirements for reusing satellites and related materials left in GEO a brief study is performed of GEO servicing potential needs. The roles of the proposed type of service vehicle include automated refueling, unit replacement, orbit-resource conservation, and material-resource utilization. Although the economic benefits of the Geostationary Service Vehicle are initially outweighed by the cost associated with robotics development, this type of service vehicle can eventually make satellite resources more efficient. C.C.S.

A92-25796#

MISSION ARCHITECTURES OF LUNAR EXPLORATION

T. IWATA (NASDA, Tsukuba Space Center, Japan) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 14 p. (AIAA PAPER 92-0358) Copyright

Possible mission architectures of lunar exploration are discussed considering programmatic and technological reality. Minimum-sized manned outpost on the moon will be the first goal in building mission architectures. Sequential launch of unmanned precursors which include lunar orbiter, lander, exploring rovers, unmanned laboratories and sample return system are investigated. A man-tended outpost is studied as the first goal of lunar exploration. Author

A92-26840

TROPICAL RAINFALL MEASURING MISSION (TRMM) PROJECT. IV - SUMMARY OF TRMM PROJECT

KEN'ICHI OKAMOTO, TASUKU TANAKA, and MARVIN GELLER (Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 11, June 1990, p. 45-55. In Japanese. refs

The principal features of the TRMM project, designed to provide quantitative measurements of rainfall over all the land and ocean areas of the tropics, are outlined. The major data product is monthly averaged rainfall rate over an area of about 600 x 600 km. The TRMM satellite will carry three rain sensors: a visible/infrared radiometer, microwave radiometers, and a rain radar. The inclination of the satellite orbit will be 35 deg; the altitude will be 350 km. The satellite will weigh about 2.2 tons and have a three-year mission life. The data will be transferred to a ground station via a tracking and data relay satellite system. V.L.

A92-28208*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

TROPICAL RAINFALL MEASURING MISSION - US/JAPAN SCIENCE OPERATIONS

THOMAS KEATING and THOMAS RYAN (NASA, Goddard Space Flight Center, Greenbelt, MD) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 6 p. (AIAA PAPER 92-0594) Copyright

The Tropical Rainfall Measuring Mission (TRMM) is a joint-venture between the National Aeronautics and Space Administration (NASA) and the National Space Development Agency (NASDA) of Japan. This cooperative program provides the resources required to place in a low-earth orbit a 3500 kilogram (kg) satellite. The satellite carries a complement of instruments designed to measure the tropical and subtropical rainfall as required to provide data products which will lead to climate modeling. This paper describes the mission, the spacecraft and instrument complement, and the data processing, distribution, and archiving system. Included in the paper is the possible, but not approved, an experimental data relay link using a NASDA data relay satellite. Author

A92-35601

SPACE STATION CONFERENCE, 7TH, TOKYO, JAPAN, APR. 16, 17, 1991, PROCEEDINGS

12 ASTRONAUTICS (GENERAL)

Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, 136 p. In Japanese. For individual items see A92-35602 to A92-35649.

Papers are presented on such topics as the operation and utilization of the Japanese Experiment Module (JEM); the Experiment Logistics Modules of the JEM; the basic design of the communication control system of the JEM; the development of the module pressurized section of the JEM; and JEM payload integration. Attention is also given to the development of solid lubrication for use in space; experiments on a space data communication protocol using the Japanese domestic communications satellite CS-3; adaptive control of large space structures and sensor collocation; motion control tests of space robots using a 2-D model; and the concept of the manned service platform. Y.P.Q.

A92-35603 UTILIZATION PLANS ON THE JAPANESE EXPERIMENT MODULE (JEM)

SHINICHI YORIDA and K. OKAMI (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 1, 2. In Japanese.

The process of the utilization plans on the Japanese Experiment Module (JEM) is discussed. The consumption rate of electric power and crew members' activities are analyzed. The payoff matrix of the JEM is calculated. Y.P.Q.

A92-35619 MAINTAINABILITY OF THE JAPANESE EXPERIMENT MODULE

M. SHIMODAIRA (NASDA, Tokyo, Japan) and S. FUJISAKI (Manned Space Systems, Inc., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 33, 34. In Japanese. refs

The maintainability concept for the Japanese Experiment Module (JEM) is presented. The evaluation model for the maintainability of the JEM is discussed, and the integrated logistics support requirement is reviewed. Y.P.Q.

A92-35620 INTRODUCTION OF THE CONCEPT OF TECHNICAL SUPPORT FOR THE JAPANESE EXPERIMENT MODULE (JEM)

Y. OKAMI (NASDA, Tokyo, Japan), MITSUHIRO SAKAMOTO, and T. TORIMI (Manned Space Systems, Inc., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 35, 36. In Japanese.

Ground support technology for the Japanese Experiment Module (JEM) is introduced. The critical operation support, maintenance design, and technical information management are emphasized. The system simulator is described. Y.P.Q.

A92-35643 AN OUTLINE OF THE IML-2 (INTERNATIONAL MICROGRAVITY LABORATORY) PROJECT

KAZUMI OKUDA, SHUNJI NAGAOKA, H. SUZUKI, and B. NAKAI (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 91, 92. In Japanese.

The International Microgravity Laboratory (IML) project for the utilization of space is presented. The introduction and current development of the IML-2 project are discussed. Y.P.Q.

A92-35646 EXPERIMENTAL EQUIPMENT OF A SMALL ROCKET

SUSUMU YOSHITOMI (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 97, 98. In Japanese.

The TR-1A small rocket for experiments on space environment utilization is discussed. The experimental equipment of the TR-1A

rocket and the experimental tasks are described. The configurations and performance of the experimental equipment are presented. Y.P.Q.

A92-35648 AIRCRAFT MICROGRAVITY TESTS USING A 'GLOVE BOX'

HIDEO SUDO, YOSHIHISA YAMAZAKI, H. FUJIMORI, and M. KOZUMA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 101, 102. In Japanese.

The performances of the 'glove box' breadboard model are introduced and its functional blocks are shown. The objectives of the experiment are discussed, and the configurations of the 'glove box' are outlined. Y.P.Q.

A92-35649 TESTS ON THE KC-135 AIRCRAFT USING A 'GLOVE BOX'

HIDEO SUDO, YOSHIHISA YAMAZAKI, H. FUJIMORI, and M. KOZUMA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 103, 104. In Japanese.

The KC-135 aircraft microgravity experiment is discussed. The characteristics of the breadboard model are described, and test results and projected future developments are outlined. Y.P.Q.

A92-38205 SOLAR SAIL DESIGN AND THE EARTH MOON RACE

JEAN-YVES PRADO IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 32-41. refs

Solar sails are large, lightweight reflectors that use the photonic pressure of solar light as a means to the gaining of thrust; impulse is proportional to the cosine of the angle of the direction of photons' arrival with the sail normal, and pressure is proportional to the square cosine of the inclination angle of the sail normal with respect to the direction of the sun. An account is presently given of the design of the requisite sail masts, the sail materials, steering principles, mass budgets, and general design rules for first-generation solar sails, as well as speculations on the character of second-generation designs. O.C.

A92-38248 JAPANESE EXPERIMENT MODULE

TAKEHIKO KATO (NASDA, Reston, VA) IN: Space Congress, 26th, Cocoa Beach, FL, Apr. 25-28, 1989, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1989, p. 7-20 to 7-31. refs

Copyright
The general configuration and the primary characteristics and functions of the Japanese Experiment Module (JEM), Japan's contribution to the Space Station Freedom Program, are discussed. The baseline functions of the JEM will include general scientific experiments and technological development, including microgravity research. The JEM consists of three functionally integrated structural elements, a Pressurized Module, an Exposed Facility, and an Experiment Logistic Module. The current status of the program is reported. V.L.

A92-41831 EFFECTS OF SPACE FUEL STATION ON THE TRANSPORTATION SYSTEM CAPABILITY AND COST - TWO CASE STUDIES

SHINICHI NAKASUKA (Tokyo, University, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, no. 106, Feb. 1992, p. 226-239. refs

The influence of a space fuel station on novel transportation schemes, which are based on reusable, space-based orbital transfer vehicles (OTV) and the separate launch of payloads, is discussed. Two case studies are considered, namely, the OTV network, which manages earth orbital missions, and the earth-moon

transportation system, which is designed for a manned lunar base project. It is concluded that, for both cases, cost reduction by the fuel station and vehicle reusability becomes significant when the demand size exceeds a certain level. The problem of large initial cost can be mitigated by using the same fuel stations for various transportation needs, including earth orbital, lunar, and interplanetary missions. O.G.

A92-45377

ASSESSMENT OF AEROSPACE TECHNOLOGY IN JAPAN VIEWED FROM AN AMERICAN PERSPECTIVE

FLOYD A. WYCZALEK (FW Lilly, Inc., Birmingham, MI) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 13-20. refs

(SAE PAPER 911968) Copyright

A review is presented of aerospace technology in Japan, the national vision supporting it and the strategy that underlies its ultimate purpose. Attention is given to the design and development history of domestic Nippon launch and space vehicles and to the two principal space agencies, ISAS and NASDA. It is noted that the long term terrestrial goal for the nation is focused on an all electric, high-technology, computer-controlled information-based society early in the 21st century. R.E.P.

A92-50178

TELESCIENCE TESTBED EXAMINATION ABOARD JAPANESE EXPERIMENT MODULE (JEM) - LIFE AND MATERIAL SCIENCE EXPERIMENTS

K. MATSUMOTO (National Aerospace Laboratory, Chofu, Japan), Y. FUJIMORI, M. SHIMIZU, R. USAMI, T. KUSUNOSE (NASDA, Tokyo, Japan), H. KIMURA (National Research Institute for Metals, Tokyo, Japan), M. OHYAMA, S. ISHIKURA (Japan Space Utilization Promotion Center, Tokyo), H. NISHIDA (Fujitsu, Ltd., Kawasaki, Japan), N. NEGISHI (Mitsubishi Heavy Industries, Ltd., Kobe, Japan) et al. (Living and working in space; IAA Man in Space Symposium, 9th, Cologne, Federal Republic of Germany, June 17-21, 1991, Selection of Papers. A92-50151 21-54) Acta Astronautica (ISSN 0094-5765), vol. 27, July 1992, p. 167-173. refs

Copyright

A telepresence ground tested experiment was conducted to extract requirements for a communication method to evaluate the influence of transmission delay and capacity on experiment operations and to evaluate performance and functions of the system for the testbed experiment. The microscopic operations experiment, image-furnace experiment, and the onboard training experiment were selected as typical ground testbed experiments. In these experiments, motion video transmission at 320 kbps was acceptable for observing the experiments and communicating between the principal investigator and the payload specialist. In the microscopic operations experiment, motion video transmission at 1.5 Mops or more was required for detailed observation. A 4-second transmission delay (roundtrip) was allowable for mutual communication. Author

A92-51697

JAPAN SETS OUT TO THE MOON AND MARS

HITOSHI MIZUTANI (Institute of Space and Astronautical Science, Sagami-hara, Japan) Planetary Report (ISSN 0736-3680), vol. 12, no. 4, July-Aug. 1992, p. 12, 13.

Copyright

Two major planetary missions under Japanese space agencies to the moon and Mars are described called Lunar A and Planet B, respectively. The missions are intended to recover global geochemical and geophysical data from the two bodies with probes of the lunar surface and of the Martian atmosphere. Collaboration with other international partners is noted, and the projects are expected to yield important planetary data on magnetic fields and seismic activity. C.C.S.

A92-53451

INTERNATIONAL SYMPOSIUM ON SPACE TECHNOLOGY AND SCIENCE, 17TH, TOKYO, JAPAN, MAY 20-25, 1990, PROCEEDINGS. VOLS. 1 & 2

KYOICHI KURIKI, ED. (Institute of Space and Astronautical Science, Sagami-hara, Japan) Symposium sponsored by Aishin Seiki Co., Ltd., IBM Japan, Japan Broadcasting Corp., et al. Tokyo, AGNE Publishing, Inc., 1990, p. Vol. 1, 1228 p.; vol. 2, 1193 p. For individual items see A92-53452 to A92-53787.

Copyright

Various papers on space technology and science are presented. The general topics addressed include: national space programs; propulsion; materials and structure, flight dynamics and astrodynamics; fluid dynamics; thermal environment and thermochemistry; electronic components and devices; computer and data systems; guidance, navigation, and control; robotics; systems engineering. Also discussed are: space transportation systems; spacecraft systems; space station and manned flight; balloons; satellite communications and broadcasting; lunar and planetary exploration; space science; earth observations; space medicine; space biology; microgravity; space industrialization; space law and international cooperation. C.D.

A92-53460

NATIONAL SPACE PROGRAM IN JAPAN

TOMONAO HAYASHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 71-77.

Copyright

The history of the Japanese space effort is briefly reviewed, emphasizing recent activities. Japanese space budgets, the achievements of NASDA satellite launches, and rocket configurations are shown. Plans for future satellite launches are briefly considered. C.D.

A92-53537

A BRIEF SURVEY OF INTERPLANETARY MISSIONS IN LATE 90S

JUN'ICHIRO KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 641-645. refs

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A brief survey is presented of launch opportunities toward various planets from the late 90s to the beginning of the 21st century. Considered are: Venus and Mars missions, Jupiter and Saturn programs, Mercury Orbiters, comet coma sample and return, and asteroid rendezvous, sample, and return. C.D.

A92-53635

CONCEPTS OF FLIGHT EXPERIMENTS FOR HOPE DEVELOPMENT

HIROSHI SASAKI, TETSUICHI ITO, TOSHIO AKIMOTO, HIROSHI MIYABA, and MOTOYUKI INABA (NASDA, Tsukuba Space Center, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1319-1324.

Copyright

In connection with NASDA's design studies for HOPE, the H-II launch vehicle-lofted manned orbiter whose first flight is projected for the late 1990s, efforts are being made toward proof-of-concept (1) orbital reentry, 'OREX', (2) hypersonic flight, 'HYFLEX', and (3) approach and landing, 'ALEX' experiments, using small, simplified scale models of HOPE. Structures and materials suited to the mission segment in question are used in each of the three test series. O.C.

12 ASTRONAUTICS (GENERAL)

A92-53652

SATELLITE HITCHHIKER PAYLOAD AND LOW-COST EARTH STATION DESIGN FOR PAN-PACIFIC INFORMATION NETWORK

NAOTO KADOWAKI (Communications Research Laboratory, Kashima, Japan), RYUTARO SUZUKI, TAKASHI IIDA (Communications Research Laboratory, Koganei, Japan), HISASHI MORIKAWA (NASDA, Tokyo, Japan), ISAO NAKAJIMA (Tokai University, Kanagawa, Japan), and YOSHIAKI NEMOTO (Tohoku University, Sendai, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1453-1458. refs

Copyright

The Pan-Pacific Information Network (PPIN) will be composed of simple, low-cost earth stations for mutual communication and information exchange in the fields of education, research, and health services for the entire Pacific region. A satellite transponder dedicated to the PPIN as a 'hitchhiker' payload is presented. Attention is given to the tradeoffs between frequency selection, hitchhiker payload requirement, and earth station. The projected cost of earth stations based on this technology is only \$6,700.

O.C.

A92-53654

ON-ORBIT EXPERIMENTS WITH SMALL SATELLITES

ATSUSHI NAKAJIMA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1465-1470. refs

Copyright

Japan's NAL has conducted orbital experiments with the small satellites of the Magnetic Bearing Flywheel Experimental System, designated 'Jindai', and Deployable Boom and Umbrella Test, designated 'Orizuru' projects. While Jindai has tested magnetic bearings useful for spacecraft attitude-control devices, Orizuru confirmed the operational characteristics of the 'umbrella' that will be used as an aerodynamic brake system representative of future 'boomerang' spacecraft. Orizuru also tested a low cost bus system.

O.C.

A92-53661

CONFIGURATION OF MANNED SERVICE PLATFORM AND ITS ASSEMBLY SCENARIO

KAZUMI OKUDA (NASDA, Space Experiment Group, Tokyo, Japan), YOSHINORI YUZAWA, MICHIIKO HORIE, and AKIRA KITAMURA (Ishikawajima-Harima Heavy Industries Co., Ltd., Space Development Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1517-1528. refs

Copyright

A permanently manned service platform (MSP) is envisioned which will address the need of other spacecraft for orbital replacement unit-related maintenance, the recovery of experimental and/or industrial products, and the delivery of propellants and other supplies. The MSP may be launched by the H-II launch vehicle after 2010; if the MSP is expanded, it could constitute a Japanese Space Station in LEO. An evaluation is presently made of mission priorities, systems, and operational plans for three candidate MSP configurations.

O.C.

A92-53663

CURRENT STATUS OF JEM OPERATIONS SYSTEM

AKIRA TANAKA and YASUSHI HORIKAWA (NASDA, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1535-1540.

Copyright

NASDA is developing the operational process and systems requirements of the Japanese Experiment Module, in keeping with agreements concluded with several other nations' space agencies. Attention is being given to operational planning, launch site

operations, logistics support, payload integration, and crew training. A preliminary design stage for JEM operational systems is being approached.

O.C.

A92-53672

A MODEL EXPERIMENT OF THE VENUS BALLOON

JUN NISHIMURA, NOBUYUKI YAJIMA, MASAMI FUJII, and RIKIO YOKOTA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1589-1592. refs

Copyright

In order to explore the Venus atmosphere, characteristics of several types of Venus balloons have been investigated. Water vapor in the balloon gives buoyancy in the carbon dioxide atmosphere of Venus. In this case the phase transition of vapor to liquid occurs as the temperature changes with the altitude of the Venus atmosphere. Thus, the phase transition of vapor to liquid in the balloon works to stabilize the balloon altitude. A method of a model experiment in a water vessel for the phase transition balloon is proposed and some results obtained in this model experiment are described.

Author

A92-53709

LUNAR AND INTERPLANETARY EXPLORATIONS BY ELECTRIC PROPULSIONS IN THE 1990S

KYOICHIRO TOKI, HITOSHI KUNINAKA, NOBUAKI ISHII, and JUN'ICHIRO KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1837-1844. refs

Copyright

Japan's Institute of Space and Astronautical Science has undertaken an evaluation of electric (rather than chemically-fueled) propulsion systems for lunar and planetary missions in the 1990s. A lunar-penetrator and a Venus orbiter mission are taken as baselines against which to determine the characteristics and evaluate the implementation constraints of realistic electrically propelled vehicles. Attention is given to dc arcjet thrusters. It is suggested that solar cell output should be shared through the spacecraft power bus rather than dedicated to propulsion.

O.C.

A92-53712

LUNAR POLAR ORBITER AND LANDING PROBE

TSUTOMU IWATA, TAKAO ETO (NASDA, Tsukuba Space Center, Japan), KAZUMI OKUDA, KAZUO OTA (NASDA, Tokyo, Japan), YUTAKA KANEKO, and RYOICHI IMAI (NASDA, Tsukuba Space Center, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1859-1864. refs

Copyright

A feasibility study of the Lunar Polar Orbiter (LPO) and small Landing Probe tentatively planned to be launched in 1997 by H-II launch vehicle is presented. The mission objectives of the LPO are to provide global geographical and elemental composition data about the lunar surface. Three types of LPO systems have been studied according to three different requirements of the mission candidates. Each LPO system can be designed by best utilizing the up-to-date earth observation satellite technologies without any major technical challenges. As for the Landing Probe, Navigation and Guidance, Landing Radar, Engine Throttling and Landing Gear are the key technologies which require further research effort.

Author

A92-53714

MARS OBSERVER MISSION DESIGN BY H-II LAUNCH VEHICLE

NOBUAKI NAGAOKA, MEGUMI SUZAKI, YOSHIO TORIYAMA (Toshiba Corp., Kawasaki, Japan), TSUTOMU IWATA, and TAKAO ETO (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25,

1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1871-1877.

Copyright

In order to maximize the Mars observer mission results obtainable under stipulated conditions for a single launch of a two-stage H II-booster, a 200-km near-circular orbit is first reached by the first two stages; the Mars observer spacecraft is then placed in a heliocentric transfer orbit to Mars by the restarting of the H II second stage. After reaching a circular orbit of Mars, a rendezvous maneuver with either Phobos or Deimos is undertaken. The 'bus' portion of the observer spacecraft is eventually separated and placed in an earth orbit-return trajectory. O.C.

A92-53724

MUSES-B - JAPANESE SPACE VLBI SATELLITE

TOSHIMITSU NISHIMURA, HARUTO HIROSAWA, HISASHI HIRABAYASHI (Institute of Space and Astronautical Science, Sagami-hara, Japan), KIYOSHI MURATA, TAKESHI ORII, and EIJI NAKAGAWA (NEC Corp., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1941-1945. refs

Copyright

Japan's Institute of Space and Astronautical Sciences has undertaken the development of the MUSES-B radio astronomy satellite, which when launched in 1995 will use space VLBI as well as space observations for simultaneous coordination with ground-based VLBI. The space deployment of an orbiting telescope will require the development of suitable deployment mechanisms, low noise signal reception techniques, and an ultrastable phase-reference transfer from the ground station to the satellite. An account is given of the development status of the satellite's design and the organization of international cooperation. O.C.

A92-53733

PRELIMINARY STUDY ON MISSION REQUIREMENTS FOR JAPANESE POLAR PLATFORM (JPOP)

KOHEI ARAI (NASDA, Earth Observation Center, Saitama; Saga University, Japan) and TAKASHI MORIYAMA (NASDA, Earth Observation Center, Saitama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2003-2008. refs

Copyright

Three mission models have been used in a preliminary study of the satellite bus instrument design that is to be used by JPOP; these models are for: (1) global climate change and hydrological system studies, (2) geological processes, the hydrological cycle, and the earth radiation budget, and (3) oceanographic and atmospheric studies. The 'pushbroom' microwave radiometer system is chosen to implement the required wide field-of-view visible and thermal IR radiometry operations. O.C.

A92-53775

A REVIEW OF THE JAPANESE SPACE PROGRAM BY COMPARISON TO THE US SPACE PROGRAM

DAMON R. WELLS and DANIEL E. HASTINGS (MIT, Cambridge, MA) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2281-2286. refs

Copyright

An evaluation is conducted of the character of the Japanese Space Program relative to its American counterpart, with a view to budgeting practices and technical capabilities. The H-II heavy launch vehicle program has already indicated the difficulties inherent in the development of large and complex space technologies that will be increasingly encountered as Japan undertakes to create an autonomous infrastructure in orbital space. It is expected that the bulk of Japanese concern will remain the design and production of system components and supporting hardware. O.C.

A92-53776

THE ECONOMICAL AND TECHNOLOGICAL STUDY OF THE GEOSTATIONARY SERVICE VEHICLE

YOSHITSUGU YASUI and TETSUO YASAKA (NTT, Radio Communication Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2287-2292. refs

Copyright

Japan's currently envisioned geostationary service vehicle (GSV) will achieve high operational efficiencies by precluding all services that require large quantities of consumables. GSV coasts along the GEO and services a number of different satellites on demand; in this way, it is expected to make some 200 rendezvous over the course of its service life with neither retrieval nor resupply. GSV's primary goal will be the visual inspection or other remote examination of customer satellites. It can also assist in malfunctioning satellite recovery and satellite orbit transfer operations. O.C.

A92-55571* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE TROPICAL RAINFALL MEASURING MISSION AND THE DEVELOPMENT OF ITS OBSERVATORY

THOMAS A. LAVIGNA, HELMUT P. CLINE, and THOMAS KEATING, JR. (NASA, Goddard Space Flight Center, Greenbelt, MD) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. refs

(IAF PAPER 92-0082)

The paper describes a cooperative program between NASA and NASDA, the Tropical Rainfall Measuring Mission (TRMM), which is an earth system science mission designed to study characteristics of the rainfall occurring over the tropics and subtropics. The salient features of the TRMM are described, with special attention given to the mission parameters, the instrument complement, the TRMM observatory, and the command and data handling subsystem. Also discussed are the TRMM requirement factors and the resulting approach to the TRMM observatory design. I.S.

A92-55662

THE GLOBAL SOLAR SYSTEM EXPLORATION PROGRAM

JIM DONAHUE (Booz, Allen & Hamilton, Inc., Washington) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 12 p. refs

(IAF PAPER 92-0214) Copyright

A Global Solar System Exploration Program is proposed which is based on recent post-Cold War models involving collective actions of nations to achieve international burden sharing. Each participating space agency would provide complementary missions and capabilities incorporating traditional models of space cooperation. A new international coordination agency is proposed to facilitate the unprecedented degree of international cooperation necessary for the global program. O.G.

A92-55859

SIMULATION STUDY OF VENUS BALLOON SYSTEM

R. AKIBA, M. HINADA, and T. NAKAJIMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p. refs

(IAF PAPER 92-0559) Copyright

The concepts of a balloon system for the research of the Venusian atmosphere is investigated analytically and experimentally by considering two systems: (1) a system consisting of only one balloon which contains two gas components (such as He and pentane); (2) a system consisting of two balloons, with one containing a small-molecular weight gas such as He and the other an organic gas such as pentane. The buoyancy in these systems is controlled using the phase transition phenomena of pentane. Experimental results using a two-balloon system concept are presented, demonstrating that the concept is valid. I.S.

12 ASTRONAUTICS (GENERAL)

A92-57115

JAPANESE SPACE STATION PROGRAM OVERVIEW

K. IDA, J. YOSHIHARA (Science and Technology Agency, Tokyo, Japan), K. YONEYAMA, and K. SHIRAKI (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p.
(IAF PAPER 92-0683) Copyright

The Japanese Experiment Module (JEM) which will be attached to SSF is reviewed focusing on the current status, funding situation, overall schedule, and results of technical development tests. It is concluded that Japan established the basic utilization policy, conducted the JEM preliminary design review, and performed development tests. O.G.

N92-13089*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

ASTRO-D

G. W. OUSLEY, SR. and Y. TANAKA /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

ASTRO-D, which is to be launched by a MU-3II vehicle, is a scientific Earth orbiting satellite of the Institute of Space and Astronomical Science (ISAS) of Japan. It will be launched in Uchinoura, Kagoshima Prefecture, Japan. The Deep Space Network will support 4 to 8 contacts per day, depending on the launch and early orbit phase (LEOP) and mission phase, providing only downlink telemetry recording to all stations. Data is given in tabular form for network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13090*# National Space Development Agency, Tokyo (Japan).

BROADCASTING SATELLITE-3A AND -3B (BS-3A AND 3B)

M. HORII and K. FUNAKAWA /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

The BS-3A and -3B will provide direct color TV broadcasting to the Japanese mainland and remote islands. The satellites will be launched from Tanegashima Space Center by a type H-1 launch vehicle. The coverage will consist of the 26-m antenna and the 34-m antenna as a backup support for the transfer and drift orbits. Maximum support will consist of one 8-hour track per station for a seven day period, plus 23 days of contingency support from all complexes. Information is given in tabular form for Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13095*# National Space Development Agency, Tokyo (Japan).

ENGINEERING TEST SATELLITE VI (ETS-VI)

M. HORII and K. FUNAKAWA /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

The Engineering Test Satellite-VI (ETS-VI) is being developed as the third Japanese three-axis stabilized engineering test satellite to establish the 2-ton geostationary operational satellite bus system and to demonstrate the high performance satellite communication technology for future operational satellites. The satellite is expected to be stationed at 154 deg east latitude. It will be launched from the Tanegashima Space Center in Japan by a type H-II launch vehicle. The Deep Space Network (DSN) will support the prelaunch compatibility test, data interface verification testing, and launch rehearsals. The DSN primary support period is from launch through the final AEF plus 1 hour. Contingency support is from final AEF plus 1 hour until launch plus 1 month. The coverage will consist of all the 26-m antennas as prime and the 34-m antennas at Madrid and Canberra as backup. Maximum support will consist of two 8-hour tracks per station for a 7-day period, plus the contingency support, if required. Information is given in tabular

form for DSN support, telemetry, command, and tracking support responsibility. Author

N92-13101*# National Space Development Agency, Tokyo (Japan).

GEOSTATIONARY METEOROLOGICAL SATELLITE-5 (GMS-5)

M. HORII /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

The Geostationary Meteorological Satellite (GMS-5), which is being developed by the National Space Development Agency of Japan (NASDA), is the fifth geostationary, spin stabilized, weather satellite. Its purposes are to observe cataclysmic events such as hurricanes, typhoons, and regional weather phenomena; to relay meteorological data from surface collection points to the Data Processing Center in Japan; and to transmit processing imaging data for facsimile reproduction. The satellite will be launched from the Tanegashima Space Center (TaSC) in Japan by a type H-II launch vehicle. The Deep Space Network (DSN) will support the transfer and drift orbit mission phases. The coverage will consist of the 26-m antennas as prime and the 34-m antenna at Madrid as backup support for launch through drift orbit. Maximum support will consist of two 8-hour tracks per station for a seven day period, plus 23 days of contingency support from all complexes. Information is given in tabular form for DSN support, frequency assignments, telemetry, command and tracking station responsibility. Author

N92-13117*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

MUSES-A

T. NISHIMURA and T. HAYASHI /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

The MUSES-A spacecraft mission objectives are to study the effect of a double lunar swingby technique, lunar orbital insertion, obtain experience using optical navigation equipment, measure mass and momentum of micrometeoroids by using a particle dust counter, and to support a packet telemetry and Reed-Solomon coding experiment by using a newly developed fault tolerant onboard computer. A flight profile is given, and information is presented in tabular form on the following topics: Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13125*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

SOLAR-A

K. NINOMIYA and Y. OGAWARA /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

The DSN (Deep Space Network) mission support requirements for SOLAR-A are summarized. The SOLAR-A mission objectives are to investigate high energy phenomena of the Sun using x-ray telescopes and spectrometers during the maximum activity period of the solar cycle. The spacecraft will be launched into a circular earth orbit of approximately 500 km altitude and 31 deg inclination. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13126*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

SPACE FLYER UNIT (SFU)

T. NINOMIYA and K. KURIKI /in JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements 4 p Oct. 1991

Avail: CASI HC A01/MF A03

The DSN (Deep Space Network) mission support requirements

for the Space Flyer Unit (SFU) are summarized. The SFU is an unmanned, reusable, and retrievable free-flying platform for multipurpose use. The SFU spacecraft will carry seven individual experiments to be completed during its mission period. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-22089# National Space Development Agency, Tokyo (Japan).

PREPRINTS OF NASDA'S 5TH TECHNICAL SYMPOSIUM

1 Jun. 1990 194 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 1 Jun. 1990

(JTN-92-80273) Avail: CASI HC A09/MF A03

Topics addressed include: space processing, microgravity experiment rocket, low gravity manufacturing, spaceborne experiments, manned orbital laboratories, environmental laboratories, ground test facilities, environmental tests, communications technology satellite, spacecraft performance, spacecraft antennas, satellite antennas, deployable antennas, semiconductor devices, radiation hardening, space station payloads, spacecraft models, satellite models, spacecraft structures, load tests, vibration tests, shock tests, marine observation satellite, satellite-borne instruments, and extraterrestrial radiation.

Author (NASDA)

N92-24785# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

NAVIGATION AND GUIDANCE TECHNIQUE FOR SFU'S RENDEZVOUS WITH SPACE SHUTTLE

KEIKEN NINOMIYA (Tokyo Univ. (Japan).), TOSHIMITSU NISHIMURA (Tokyo Univ. (Japan).), TETSUO YAMAGUCHI (Mitsubishi Electric Corp., Amagasaki (Japan).), MASAO SATO (Mitsubishi Electric Corp., Amagasaki (Japan).), and KATSUMI TSUKAHARA (Mitsubishi Electric Corp., Kanagawa, Japan) In ESA, Spacecraft Flight Dynamics p 481-486 Dec. 1991 Copyright Noordwijk, Netherlands, HC 90 Dutch guilders Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC.

The Space Flyer Unit (SFU) is a retrievable and reusable platform which will be utilized for many kinds of scientific and engineering experiments in space. SFU was launched by a Japanese H2 launch vehicle and is to be retrieved by a U.S. Shuttle orbiter. The functions of the navigation, guidance and control subsystem (NGC) of SFU are autonomous navigation and guidance for rendezvous with STS using Global Positioning System (GPS), Inertial Measurement Unit (IMU), and NGC Computer (NGCC), as well as attitude control of an ordinary three axis controlled spacecraft. The design status of autonomous navigation and guidance logic for rendezvous with STS, and ground support functions are discussed. ESA

N92-32015 Nissho Iwai Corp., Tokyo (Japan).

THE TRADING COMPANY IN SPACE DEVELOPMENT IN JAPAN

TOSHI N. GONDA In Huntsville Association of Technical Societies, TABES 92: 8th Annual Technical and Business Exhibition and Symposium. Executive Summaries and Submitted Papers 6 p 1992

(TABES PAPER 92-424) Copyright Avail: Issuing Activity

Trading companies have a unique status in the Japanese market and a really deep involvement in Japanese trade. They are also involved in space development and the space industry as well. An overview of trading companies activities and, more specifically, a way of involving them more in the space industry are presented. The activities of Nissho Iwai Corporation, one of the Sogo Shosha, are described in detail. Their activities in the space industry have two aspects, one is social and the other is commercial. They have been stimulating space projects in these aspects. There are several international cooperative space projects between Japan and the U.S. These projects are proceeding on a government to

government basis. But, it is worthwhile to realize that the Sogo Shosha may create trade flow through increased international space cooperation in the private sector. Author

N92-33759# National Space Development Agency, Tokyo (Japan). Program Planning and Management Dept.

FUTURE SPACE ACTIVITIES CONDUCTED BY THE NATIONAL SPACE DEVELOPMENT AGENCY OF JAPAN [NASDA NO SHOURAI NO UCHUU KATSUDOU]

YOUJI SHIBATOU In its Future Space Activities Workshop: Lunar Base Workshop 1991 10 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A02/MF A10

The present status and future prospects of launch vehicle and satellite development programs, earth observation programs, and space utilization programs (including participation in international projects), are outlined. Technology development problems related to the following subjects are presented: space transportation systems (space shuttle and orbit transfer vehicles, and manned systems); satellites (scaling-up, increasing electric power supply, and service life); and others (rendezvous and docking, space robot, manned space, and moon and planet development and utilization technologies). Author (NASDA)

N92-33760# National Space Development Agency, Ibaraki (Japan).

UNMANNED MARS EXPLORATION MISSION [MUJIN KASEI TANSU MISSION]

TOSHIHIDE MAEDA In its Future Space Activities Workshop: Lunar Base Workshop 1991 24 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A03/MF A10

Reviews of the unmanned Mars exploration missions and their candidate spacecraft are presented. The results of initial analyses are reported for the following: (1) Mars transfer orbits; (2) launching by H-2 launch vehicles and injection into Mars orbits; and (3) return-to-earth orbits. The purpose, system outline, and necessary equipment are presented for the following spacecraft: (1) Mars Moon Sample Return (MMSR) (from Phobos and Deimos); (2) Mars Landing Explorer (MALE); and (3) Mars Mobile Explorer (MAME). Author (NASDA)

N92-33854# Science and Technology Agency, Tokyo (Japan).

THE 14TH SPACE STATION UTILIZATION WORKSHOP IN JAPAN

21 Jan. 1992 184 p In ENGLISH and JAPANESE Workshop held in Tokyo, Japan, 21-22 Jan. 1992 Prepared in cooperation with NASDA, Tokyo, Japan and Japan Space Utilization Promotion Center, Tokyo

(JTN-92-80388) Avail: CASI HC A09/MF A02

The proceedings from the Space Station Utilization Workshop are presented. The following topics were discussed: space stations, manned spacecraft, spacecraft modules, Japanese spacecraft, JEM (Japanese Experiment Module), research facilities, crew training, scheduling, spacecraft equipment, spacecraft instruments, research projects, project management, project planning, research management, mission planning, space station utilization by universities and industries, space manufacturing, spaceborne experiments, microgravity experiment, airborne experiment, parabolic flight, Get Away Special (GAS), space station structures, spacecraft structures, life science, fluid flow, Marangoni flow, semiconductors, crystal growth, lead tin telluride, gallium arsenides, indium phosphide, Spacelab project, and international cooperation.

Author (NASDA)

N92-33859# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

BASIC LINE OF SPACE STATION UTILIZATION IN THE UNIVERSITIES

HARUTOU HIROSAWA In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 117-118 21 Jan. 1992 In JAPANESE

Avail: CASI HC A01/MF A02

Outlines of the policy and activity status of the Committee for

12 ASTRONAUTICS (GENERAL)

Space Utilization Research in ISAS (Institute of Space and Astronautical Science) are presented. Objectives, research subcommittees, and research disciplines of the committee are explained. The SFU (Space Flyer Unit) experiment and science experiments utilizing rocket vehicles are described. Outline of IFSUSS (International Forum on the Scientific Use of Space Station) is also mentioned. Author (NASDA)

N92-33860# Tokyo Univ. (Japan). Space Utilization Center. **SCIENTIFIC UTILIZATION OF SPACE: ACTIVITIES AMONG UNIVERSITIES** MASAMICHI YAMASHITA In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 119-122 21 Jan. 1992
Avail: CASI HC A01/MF A02

The status of the Committee for Space Utilization Research in the Institute of Space and Astronautical Science (ISAS) is outlined in viewgraph form. The following topics are addressed: an explanation of the committee and the six research sub-committees; the disciplines which are stressed by the committee; the status of the ground-based research for space station studies, space flyer units experiment program, and rocket experiment; and the International Forum on Scientific Use of Space Station (IFSUSS). Author (NASDA)

N92-33861# Japan Space Utilization Promotion Center, Tokyo. **BASIC LINE OF SPACE STATION UTILIZATION IN THE INDUSTRIAL CIRCLES** YASUAKI HASHIMOTO In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 123-130 21 Jan. 1992 In JAPANESE
Avail: CASI HC A02/MF A02

The Japan Space Utilization Promotion Center (JSUP) obtained information about space station utilization through a questionnaire that was filled out by member corporations and participants in the activities of the center. Results are summarized for following items: (1) requests for Announcements of Opportunity (AO); (2) intentions for experiment expenditure; (3) objectives for participation in experiments; (4) areas of experiment; (5) subject samples of material processing experiments; (6) procedures to process AO in the responsible sections after receiving them; (7) premises for getting in-house budget; (8) items for which national budgetary support will be requested; (9) ownership of the experiment results; (10) selection criteria for proposals from private organizations; and (11) expectations of JSUP in terms of researcher support. Author (NASDA)

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ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

A92-14743
DESIGN OF MULTI-BODY LAMBERT TYPE ORBITS WITH SPECIFIED DEPARTURE AND ARRIVAL POSITIONS NOBUAKI ISHII, JUN'ICHIRO KAWAGUCHI, and HIROKI MATSUO (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs
(IAF PAPER 91-331) Copyright

A new procedure for designing a multi-body Lambert type orbit comprising a multiple swingby process is developed, aiming at relieving a numerical difficulty inherent to a highly nonlinear swingby mechanism. The proposed algorithm, Recursive Multi-Step Linearization, first divides a whole orbit into several trajectory segments. Then, with a maximum use of piecewise transition matrices, a segmentized orbit is repeatedly upgraded until an approximated orbit initially based on a patched conics method

eventually converges. In application to the four body earth-moon system with sun's gravitation, one of the double lunar swingby orbits including 12 lunar swingbys is successfully designed without any velocity mismatch. Author

A92-17879
A STUDY ON OPTIMAL RETURNS OF AN AOTV WITH THE LIMIT OF THE AERODYNAMIC HEATING HIROYUKI TAKANO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 522-530. In Japanese. refs

In this paper, optimal returns of an AOTV (Aeroassisted Orbital Transfer Vehicle) from high-earth orbit within the limit of aerodynamic heating are studied numerically, in order to minimize the characteristic velocities for decelerations and plane changes at the atmospheric flights and the impulses in space. Computations results with optimal control methods are changed by the heat limit, but characteristic velocities can still be kept small. Author

A92-23698
COMPUTER AIDED DESIGN AND VERIFICATION OF AUTONOMOUS RVD FLIGHT MANAGEMENT SYSTEM YASUFUMI WAKABAYASHI, ISAO KAWANO (NASDA, Tsukuba, Japan), NORIMASA YOSHIDA, MASANORI SATO, TATSUSHI KANBE (Mitsubishi Electric Corp., Kamakura Works, Japan), MUTSUO KITAMURA, and MASAKI ISHIKAWA (Mitsubishi Research Institute, Tokyo, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 209-212. refs

The Flight Management System (FMS) for future autonomous space vehicles with versatile capabilities such as Rendezvous and Docking will be a very complicated one. Since it must be extremely reliable as well due to safety requirement imposed on it, difficulties arise with its design and verification. An approach is proposed which utilizes prototyping at early stages of design with the aid of a specification description using object-oriented definitions of parts and a graphical representation of logics by flow chart, realized on a unified computer-aided environment. A computer program called the Flight Management Verification Program is developed which can accommodate top-level functional description of the FMS along with hardware and dynamic models of the vehicle and can execute the description with simulated errors. A series of test runs of the program demonstrate the validity of the approach. Author

A92-23715
HUGE OBJECT MANIPULATION IN SPACE BY VEHICLES HIROSHI KIMURA, ZHIDONG WANG, and EIJI NAKANO (Tohoku University, Sendai, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 283-286. refs

The studies about space robots have assumed a relatively small object as a manipulated target, but in space a target object can be relatively huge. For example the spacecraft, the space station, the solar power satellite. In these cases, manipulation by several vehicles which have a thrust engine is superior than that by arms mounted on the spacecraft. In the manipulation by vehicles, the fuel consumption in a thrust engine is related to the size of force activated by a vehicle and the size of force depends on the positions of contacting points. Therefore, contacting points of the vehicles are important in view of the fuel consumption. This paper discusses how to find the optimal contacting points. The optimal contacting points are defined as the points which minimize the norm of force needed for the specified acceleration of a target object and maximize the dynamic manipulability margin. The results of the simulation are indicated. Author

A92-25503
ON THE SKIP FLIGHT OF A SPACEPLANE MASATO KUDO and KANICHIRO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 455, 1991, p. 662-665. In Japanese. refs

Optimal paths are shown when a spaceplane skips in the uppermost atmosphere. The flight-path is optimized to give maximum terminal velocity. Typical numerical results show that the range could be doubled with one jump with the sacrifice of 15 percent of the initial velocity. Author

A92-34333#

APPLICATION OF NEURAL NETWORKS TO TRACKING ANALYSIS FOR RENDEZVOUS/DOCKING OF AN ADAPTIVE SPACE STRUCTURE

YUJI MATSUZAKI and SHINJI ABE (Nagoya University, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 531-537. refs (AIAA PAPER 92-2402) Copyright

This paper describes a computer simulation analysis on application of a neural network control to tracking of a moving target for rendezvous/docking by an adaptive space structure, in order to examine the effectiveness and feasibility of the neural network control. The self-learning process of neural network, based on the error back propagation technique, consists of two stages: a neural network as an emulator learns to emulate the docking structure kinematics which is complex due to the actuation dynamics, and then another neural network as a controller learns how to track the moving target using the learned emulator. The well-learned controller is finally used to actually control the docking structure for tracking. The example simulation has shown that the application of the neural networks is very effective in the tracking problem. Author

A92-35634

APPLICATION OF A LUNAR ORBITAL FLIGHT PLAN

M. KUSANAGI, K. NISHIYAMA, S. NOKANO, and N. ISHIKAWA (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 69, 70. In Japanese.

The development of space station to the moon and mars is discussed. The motion changes of the low earth orbits (LEO) are analyzed. Launch time and energy sources and their efficiencies are considered. Y.P.Q.

A92-35642

THE ORBITAL DEBRIS DENSITY AND EVALUATION METHODS ON THE SPACE DEBRIS COLLISION HAZARD

SHUNICHI ODA and TETSUO YASAKA (NTT, Radio Communication Systems Laboratory, Yokosuka, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 89, 90. In Japanese. refs

The orbital debris distribution, quantity and size data are obtained from a satellite situation report (SSR). Two-line-data (TLD) are used for the evaluation of the collision hazard of orbital debris. An evaluation method for collision hazards in geostationary orbit is also presented. Y.P.Q.

A92-39555

THE WORLD'S FIRST CIS-LUNAR AEROBRAKE EXPERIMENT - PRELIMINARY REPORT OF THE RESULTS

T. ABE, J. KAWAGUCHI, S. SAITO, T. ICHIKAWA, and K. UESUGI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 29-37. refs

The preliminary results of HITEN's aerobrake experiment are presented along with a brief description of the spacecraft and its mission operations. Perigee altitudes during two demonstrations were 125 and 120 km, respectively, and these values were quite close to the planned ones. Such precise targetings were accomplished without final trim maneuvers. Cancellation of trim maneuvers based on JPL orbit determination results testified to the accuracy of the ISAS cruise phase orbit determination and navigation design as well as the excellent performance of the

HITEN reaction control system used to carry out the targeting TCMS. Preliminary analysis of aerodynamic effects revealed that the observed values were close to the predicted ones in spite of some small discrepancies. C.A.B.

A92-47762

GEOSTATIONARY ORBIT DETERMINATION ACCURACY. II

SEIICHIROU KAWASE and YOSHINORI ARIMOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 461, 1992, p. 354-357. In Japanese.

Analytical formulation is presented that can evaluate the geostationary orbit determination accuracy when the range and angle measurements have bias errors. It is an extension of the evaluation formulation of a previous paper which considered only unbiased measurement noises. Another extension is mentioned that the tracking period which had been fixed at 24 hours can be made variable. Author

A92-52042

DYNAMIC ANALYSIS OF 3D MULTI RIGID BODIES WITH DISCONTINUOUS VELOCITIES

SHINJI SUZUKI and DAICHIRO MATSUNAGA (Tokyo, University, Japan) Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 462, 1992, p. 396-402. In Japanese. refs

This paper considers a method for dynamic analysis of multirigid bodies in space with impulsive forces, impact, and discontinuous velocities. The system equations of motion for rigid bodies connected with hinges are derived from the virtual work principal to the D'Alembert form of the Newton-Euler equations. Main body velocities/angular velocities and each hinge's angular velocity are used for the system variables. Discontinuities in the velocity are observed when either an impulsive torque is applied to a hinge or a sudden hinge lock occurs. A general formulation between the velocity jump and the impulsive force is presented for the system equations. The panel deployment of a spacecraft structure is numerically simulated using the method to demonstrate its capabilities. Author

A92-53006

OPTIMAL TRAJECTORIES FOR ATMOSPHERIC FLIGHTS OF AN AEROASSISTED ORBITAL TRANSFER VEHICLE

SHINJI ISHIMOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 463, 1992, p. 437-442. In Japanese. refs

Many studies have shown the advantages of an aeroassisted orbital transfer vehicle (AOTV) which uses aerodynamic forces during an atmospheric pass to achieve orbital changes. This paper discusses optimal aeroassisted maneuvers to return from geosynchronous earth orbit to low earth orbit. A trajectory optimization problem minimizing the total velocity change was formulated as a nonlinear programming problem, and numerical solutions were computed by the sequential quadratic programming method. The optimal trajectories are useful for the performance evaluation of vehicles or the design of flight profiles. Author

A92-53538

TRAJECTORY DESIGN AND CONTROL OF A MULTIPLE LUNAR SWINGBY ORBIT FOR MUSES-A

KUNINORI UESUGI, JUN'ICHIRO KAWAGUCHI, MIWAKO SHUTO, NOBUAKI ISHII (Institute of Space and Astronautical Science, Sagami-hara, Japan), MASAYUKI KAMIMURA (NEC Corp., Yokohama, Japan), SHUICHI ISHII, MASAFUMI KIMURA, and KIMIE TANAKA (NEC Aerospace Systems, Ltd., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 647-652. refs Copyright

The MUSES-A (MU Space Engineering Satellite-A) mission, which was launched on January 24, 1990, aboard the Hiten spacecraft, is discussed. The spacecraft will employ a sun-synchronized double lunar swingby orbit in its operational

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geomagnetic coverage phase. The orbital design software is described along with orbital maneuver to the first lunar swingby and the first lunar encounter and lunar orbiter insertion. C.D.

A92-53539* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AEROBRAKING STRATEGIES FOR THE SAMPLE OF COMET COMA EARTH RETURN MISSION

TAKASHI ABE, JUN'ICHIRO KAWAGUCHI, KUNINORI UESUGI (Institute of Space and Astronautical Science, Sagamihara, Japan), and CHEN-WAN L. YEN (JPL, Pasadena, CA) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 653-660. refs

Copyright

The results of a study to validate the applicability of the aerobraking concept to the SOCCER (sample of comet coma earth return) mission using a six-DOF computer simulation of the aerobraking process are presented. The SOCCER spacecraft and the aerobraking scenario and power supply problem are briefly described. Results are presented for the spin effect, payload exposure problem, and sun angle effect. C.D.

A92-53540

FUNDAMENTAL STUDIES OF DESIGNING A SOLAR SAIL ORBIT

SATOSHI EGUCHI (Tokai, University, Hiratsuka, Japan), NOBUAKI ISHII, and HIROKI MATSUO (Institute of Space and Astronautical Science, Sagamihara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 661-666. refs

Copyright

Fundamental studies for a preliminary design of solar sail orbits are described. A closed-form equation is derived from a perturbation equation in order to evaluate analytically an increment of the semimajor axis. This closed-form equation can be used to estimate the orbital period easily without numerical integration. A simple control algorithm with a constant precession rate can lessen the operational task of sail axis orientation. C.D.

A92-53644

FLIGHT DYNAMIC ENVIRONMENT OF H-II LAUNCH VEHICLE
TOMIO NAKANO, KENJI TOMIOKA, and TAKUMI UJINO (NASDA, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1395-1402.

Copyright

The flight-dynamic environment conditions for the H-II heavy-lift launch vehicle are examined. The analysis extends over liftoff, transonic flight, main engine cutoff, and payload/vehicle separation flight segments. Vibration tests were conducted on a 1/5th-scale model of the H-II; the lower-mode frequencies measured accurately reproduced those predicted analytically, and the mode-shape coincidence is found to be high except in the case of local resonances. Firing tests were also conducted with a 1/15th-scale model of the H-II to measure acoustic noise. O.C.

A92-53650

TETHER-ASSISTED DISPOSAL OF INOPERATIVE SATELLITES
JEROME PEARSON (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) and TETSUO YASAKA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1439-1445. refs

Copyright

Two methods using long tethers are examined for the disposal of inoperative satellites or debris in GEO. The disposal method is to move the orbit of the satellite 300 km from GEO to prevent interference with operating satellites. The first method uses a service vehicle with dual 300 km tethers. The vehicle docks with target number 1, then uses rocket thrust to carry the pair to target

number 2. The two satellites are extended upward and downward 300 km by the two tethers and are released in turn. After the first release, the service vehicle drifts to the next target, releases the second satellite, then uses a small rocket thrust to rendezvous with target number 3. The second method is to oscillate a single target satellite upward on the end of a 600-km tether into an in-plane pendulum mode with a libration half-angle of 15 degrees. Tether-based disposal is compared in terms of mass required with conventional rockets and with the tumble-orbit transfer, previously proposed by one of the authors. Tethers offer some advantages over rockets for the relatively low delta-v required (about 5 m/s per operation). Author

A92-53782

AN ORBITAL SEQUENCE DESIGN FOR LUNAR MISSIONS COMBINING ELLIPTIC ORBITAL SEGMENTS WITH CONSTRAINTS

HIROSHI YAMAKAWA (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2331-2336. refs

Copyright

A novel method to determine the orbital sequence is proposed for the preliminary step of mission flight planning, which includes many difficult constraints and requires an enormous quantity of calculation corresponding to launch dates and injection errors. Many discrete ellipses are prepared for the orbital region, and the orbital design is carried out by combining elliptic orbital segments which satisfy every constraint. Using this simple method, information about the launch window and the strategy for dealing with the injection errors can be acquired. Author

A92-55310#

OPTIMAL LAUNCH TRAJECTORY OF A HYPERSONIC RESEARCH VEHICLE

YOSHINORI OKUNO and SHIGEYA WATANABE (National Aerospace Laboratory, Tokyo, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 3. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 1612-1617. refs

(AIAA PAPER 92-4302) Copyright

A formulation is proposed for calculating the optimal launch trajectory of a hypersonic research vehicle boosted by a two-stage solid rocket motor. The formulation is shown to be capable of simultaneously optimizing the pitch rate control profile, second-stage propellant loading and its ignition timing, as well as the launch vehicle aerodynamic characteristics by varying the first-stage tail plane area. Numerical results are presented for a 500-kg research vehicle boosted up to 4 km/s ($M = 12$) by a two-stage launch vehicle. V.L.

A92-55400#

NATURE OF MAXIMUM HEAT RATE SEGMENT OF A MINIMUM-FUEL SYNERGETIC PLANE CHANGE

HIROYUKI TAKANO (National Defense Academy, Yokosuka, Japan) IN: AIAA Atmospheric Flight Mechanics Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 810-818. refs

(AIAA PAPER 92-4645) Copyright

A control program for the heat rate constrained synergetic plane change of an aeroassisted orbital transfer vehicle is described. Synergetic plane change is capable of considerably saving fuel and increasing the final mass. It is shown that the optimal thrust usage is quite sensitive to the magnitude of the heat rate limit. O.G.

A92-55524

EVALUATION OF MICROGRAVITY LEVEL FLUCTUATION DUE TO ATTITUDE/ORBITAL MOTION IN A TETHERED SATELLITE SYSTEM

YOSHIAKI OHKAMI (Tokyo Institute of Technology, Japan),

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

OSAMU OKAMOTO, and SHOICHI YOSHIMURA (National Aerospace Laboratory, Chofu, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 7 p. refs

(IAF PAPER 92-0028) Copyright

A method for evaluating the microgravity level inside the tethered platform which may be influenced by dynamical motion of the main base (or space station) and ballast is presented. A complete set of dynamical equations is derived for the attitude/orbital motion of the three mass system connected by tethers, with emphasis on the motion of the low-g platform placed in the middle. The solution of this equation for angular and translational velocities is substituted in an evaluation formula of the microgravity level at an arbitrary position in the platform based on a generic and rigorous definition of the microgravity. A set of linearized equations of motion is also provided. The method is of utility if implemented in digital computer simulations. P.D.

A92-55539

ANALYSIS AND PLANNING FOR PRECISE ORBITAL MANEUVERS

MEGUMI SUZAKI, KOJIRO SHODA, and MASAYUKI IKEUCHI (Toshiba Corp., Komukai Works, Kawasaki, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p.

(IAF PAPER 92-0044) Copyright

An orbit analysis is presented for an earth orbiting satellite equipped with navigation, guidance and control subsystems, whose mission requires precise maneuvers, retrieval of debris, or approaches to other satellites. Emphasis is placed on planning a practical maneuver sequence to avoid any collisions with target objectives during thruster failure by maximizing selection freedom of approach paths, considering recovery plans that employ still-available thrusters. Examples of maneuver planning with the algorithms utilized and the outline of the computer program developed are given. R.E.P.

A92-56071

VISCOUS EFFECTS ON OPTIMAL TRAJECTORIES OF THE AEROASSISTED ORBITAL TRANSFER VEHICLE

HIROKAZU SUZUKI, TSUTOMU KUSAKI, and NAOHIRO YUHARA (Nihon University, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 310-313. In Japanese. refs

The aerodynamic characteristics of the aeroassisted orbital transfer vehicle (AOTV) are presented. Viscous effects and aerodynamic heating rate are discussed for the AOTV. Orbital optimization problems are addressed. Y.P.Q.

N92-17854# National Aerospace Lab., Tokyo (Japan). Control Systems Div.

SYSTEMATIC COMPUTATION ALGORITHM TO OBTAIN OSCULATING ORBIT ELEMENTS FROM POSITION AND VELOCITY VECTORS [ICHI SOKUDO BEKUTORU KARA SESSHOKU KIDO YOSO WO MOTOMERU HOKATSUTEKINA KEISAN ARUGORIZUMU]

TORU SHIHO Sep. 1989 32 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-614; JTN-92-80250) Avail: CASI HC A03/MF A01

This report describes calculation algorithm and its systematic procedure of osculating orbital elements computation in each case of elliptic, parabolic, hyperbolic and rectilinear orbit. The osculating orbital elements are those elements applied only in specific timing when position vector and velocity vector of a spacecraft or celestial body, such as comet, are input in the calculation.

Author (NASDA)

N92-22622# National Aerospace Lab., Tokyo (Japan). Control Systems Div.

GPS SATELLITE ORBIT DETERMINATION USING PSEUDORANGE DATA: EXPERIMENTS AND RESULTS

MASAAKI MURATA, TOMIYOSHI YAMAMOTO, and YASUHIRO

HAMADA (Daiko Ltd., Japan) May 1991 19 p (ISSN 0389-4010)

(NAL-TR-1110T) Avail: CASI HC A03/MF A01

A Global Positioning System (GPS) orbit determination software system called the Multi-Satellite Orbit Processor (MSOP) has been developed, and uses pseudo range data to determine accurate orbits for the GPS satellite constellation. Methods and strategies specific to the precise orbit determination of GPS satellites are described, with special emphasis placed on force modeling of the solar radiation pressure and y-bias. The orbit accuracy was evaluated from analysis of P-code pseudorange data collected by the Cooperative International GPS Network (CIGNET), being primarily based on a direct comparison with the precise ephemerides generated at the Naval Surface Warfare Center (NSWC). Methods leading to an orbit accuracy of better than 0.5 ppm were demonstrated. Author

N92-24739*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ORBIT DETERMINATION SUPPORT FOR HITEN'S AEROBRACING IN THE EARTH'S ATMOSPHERE

L. EFRON, J. ELLIS, P. R. MENON, and B. TUCKER In ESA, Spacecraft Flight Dynamics p 141-147 Dec. 1991 Sponsored by NASA, Washington

Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Two passes of the ISAS (Japan's Institute of Space and Astronautical Science) Hiten spacecraft through the Earth's atmosphere, at perigee altitudes of 125 km and 120 km, during Mar. 1991 marked the first aerobraking technology demonstrations for an object in cis-lunar orbit traveling at near Earth escape velocity. Prediction and control of perigee altitude to better than 1 km was desired to assure spacecraft survival. Covariance analysis provided confidence that prediction accuracy better than 200 m for support of final trim maneuver design was achievable with NASA DSN (Deep Space Network) tracking support. ISAS used orbit determination results in their decisions to cancel final trim maneuvers. Post flight reconstructions, marking the first combined use of DSN and ISAS tracking data, yielded perigee altitude solutions which agree with the near real time mission operations support predictions to better than 50 m. ESA

14

GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

A92-15293

LUNAR MOBILE EXPLORER, THE VARIATIONS AND THE EVOLUTION

TSUTOMU IWATA, TAKAO ETO, YUTAKA KANEKO (NASDA, Tsukuba, Japan), HIROSHI TOMITA, MASAYUKI IKEUCHI, and YOSHIO TORIYAMA (Toshiba Corp., Komukai Works, Kawasaki, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs

(IAF PAPER 91-446) Copyright

A mission scenario and a late 1990s system concept for a Lunar Mobile Explorer (LME) using the Japanese launch vehicle H-II is presented. The system specifications, major functions, and functional requirements are shown. Attention is given to the LME guidance, navigation, control, and communication systems. C.D.

A92-20633

NASDA STUDY ON MANNED LUNAR OUTPOST

TSUTOMU IWATA, TAKAO ETO, YUTAKA KANEKO, and TOSHIHIDE MAEDA (NASDA, Tsukuba Space Center, Japan) IAF,

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs
(IAF PAPER 91-696) Copyright

The paper discusses the concept of the Lunar Outpost studied by NASDA, which is defined to be a precursor for larger-scale permanently habitable lunar bases. The modules of the Lunar Outpost will be transported by unmanned vehicles from LEO to the lunar surface and will be landed on a flat area on the east side of the lunar equator. The crew will be sent by a vehicle designed for passenger transportation. The mission objective of the Lunar Outpost are as follows: (1) the establishment of a safe and low-cost transportation system between the earth and the moon; (2) the establishment of a habitation system on the moon; (3) the scientific exploration of the lunar surface; (4) the performance of life science, space science, and physical-science experiments; (5) astronomical observations; and (6) the performance of experiments related to the lunar base construction and the utilization of lunar resources. I.S.

A92-21956

ACCELERATOR BEAM EXPERIMENTS OF A PROTOTYPE COSMIC RAY HEAVY ION TELESCOPE

TSUYOSHI KOHNO, KAZUOKI MUNAKATA, TAKASHI IMAI, AKIRA YONEDA, CHIHIRO KATO, MASARU MATSUOKA (Institute of Physical and Chemical Research, Wako, Japan), TADAYOSHI DOKE, JUN KIKUCHI, TOSHISUKE KASHIWAGI (Waseda University, Tokyo, Japan), HANK J. CRAWFORD (California University, Berkeley) et al. Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Nov. 1991, p. 3967-3975. refs
Copyright

Results are presented from accelerator beam experiments carried out on a prototype model of the Heavy Ion Telescope (HIT) scheduled for a launch in 1993 for observations of elemental and isotopic compositions of solar energetic particles and Galactic cosmic rays. In the first stage of these experiments, the HIT model was exposed to an iron beam, to check the basic characteristics of individual Position Sensitive Detectors of the telescope and of the energy-loss detectors. In the second stage, the HIT model was exposed to a secondary beam consisting of various nuclides produced by the projectile fragmentation process in a reaction induced by Fe-56 beam. These data were analyzed by the Delta E x E technique of Munakata et al. (1989), and the basic characteristics of the telescope were evaluated. I.S.

A92-23673

IHI'S R&D ACTIVITIES ON THE 2ND GENERATION SPACE ROBOTS - IHI TESTBED FOR SPACE TELEROBOTICS

YUKI YOSHIE, FUMIAKI SANO, SHIGEKI MURAYAMA, MASAHIKO UTSUMI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and TOSHIHIRO MIYASAKO (Ishikawajima System Technology Co., Ltd., Tokyo, Japan) IN: i-*SAIRAS '90*; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 93-96. refs

The testbed for space telerobotics is described in terms of its components, structure, and planned experiments with specific attention given to the operator-robot interface. The interface is composed of a dataglove, a head-mounted display (HMD), and voice-recognition and composition systems. The testbed is designed to test the teleoperation capabilities of second-generation space robots by: (1) developing an interface with the sensation of presence; (2) using a predictive display that simulates a suitable time delay; and (3) simultaneously increasing autonomous control and decreasing the operator load. The testbed is made up of a master manipulator, a stereo view system, a command input/output system, a slave robot, and a dummy orbital replacement unit. Several improvements are to be included in the testbed design including an overlay function to compare the predicted and real images. C.C.S.

A92-23678

AUTONOMOUS SATELLITE ROBOT TESTBED

TADASHI KOMATSU, MICHIOHARA UENO, SHOICHI IKURA

(Toshiba Corp., Research and Development Center, Kawasaki, Japan), HIROFUMI MIURA, and ISAO SHIMOYAMA (Tokyo University, Japan) IN: i-*SAIRAS '90*; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 113-116.

A 2D operation testbed is developed for an autonomous free-flying space robot such as an orbital maneuvering vehicle. This system basically consists of a satellite robot, a target, a host computer and a planar base. This is an intelligent machine represented by its functions which include: a vision sensing system, tactical path planning, and real-time operation. The features provided initially by the space robot testbed are described both at the subsystem level and at the fully-integrated system level.

Author

A92-23679

A PRELIMINARY STUDY ON A LUNAR MOBILE EXPLORER

TSUTOMU IWATA, TAKAO ETO, and YUTAKA KANEKO (NASDA, Tsukuba Space Center, Japan) IN: i-*SAIRAS '90*; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 123-126. refs

A preliminary study on a lunar mobile explorer is conducted by the National Space Development Agency of Japan in order to assess technical feasibility. A preliminary design configuration of the mobile explorer and several subsystems required for a successful mobile explorer are presented such as those for locomotion, navigation, communication, thermal control, and power. Autonomous navigation for the lunar mobile explorer is not as essential as in the case of the Mars rover due to much less round-trip light-time delays. The mobile explorer can navigate through teleoperation by the operator on earth all the time. But in order to lighten the burden of the operator, partially autonomous navigation is suggested in this paper.

Author

A92-23681

ROBOT'S ROLE IN LUNAR BASE DEVELOPMENT

KOHTARO MATSUMOTO (National Aerospace Laboratory, Chofu, Japan), TATSUO ARAI (Mechanical Engineering Laboratory, Tsukuba, Japan), MITSUSHIGE ODA (NASDA, Tokyo, Japan), and TAKASHI KIKUTA (Institute for Future Technology, Tokyo, Japan) IN: i-*SAIRAS '90*; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 131-134.

In the Japanese lunar base study for scientific observation and resource utilization, robots are expected to play the important role. Robots are expected to assist the lunar crew in constructing the lunar base, maintaining it, and developing it into a colony. The tasks for the lunar robot are described as are the role-sharing of humans and robots, autonomous capabilities of robots, and the work-amount estimation of initial lunar outpost in terms of the functions for robot.

Author

A92-23729

AN EXPERIMENTAL SIMULATOR FOR FREE-FLYING SPACE ROBOTS

HIRONORI FUJII, KENJI UCHIYAMA, MASAKI TAKINAMI (Tokyo Metropolitan Institute of Technology, Hino, Japan), TAKASHI UCHIYAMA (Fujitsu Laboratories, Ltd., Kawasaki, Japan), and TSUTSUO MIKAMI (Fujitsu, Ltd., Kawasaki, Japan) IN: i-*SAIRAS '90*; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 345-348. refs

A system to simulate controlled behavior of a free-flying space robot experimentally on the ground environment is introduced. The simulator is a hybrid of a software simulator to analyze motion of the free-flying robot in space environment and a hardware simulator to realize the analyzed motion on ground environment through suspension of a model of the free-flying robot by many tethers.

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Philosophy and special features of the simulator are discussed.

Author

A92-34429#

A NOVEL METHOD OF FRICTION FORCE REDUCTION BY VIBRATION AND ITS APPLICATION TO GRAVITY COMPENSATION

SABURO MATUNAGA and JUNJIRO ONODA (Institute of Space and Astronautical Science, Sagamihara, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers, Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1531-1537. refs (AIAA PAPER 92-2275) Copyright

The present method for 2D gravity concentration employs in-plane vibration, or the 'dither' effect, to decrease the time-averaged friction. The dither effect is reinvestigated for the case of a mass that slides at constant velocity on a level, in-plane vibrating table; an application of the effect to gravity compensation is presented, in conjunction with a motion test. The experimental results obtained demonstrate that this structure slides on the table with a drag/weight ratio of about $10 \exp -3$, with drag-induced accelerations of the order of $10 \exp -3 g$. O.C.

A92-35602

THE CONCEPT OF THE OPERATION AND UTILIZATION OF THE JAPANESE EXPERIMENT MODULE (JEM) AND THE GROUND FACILITIES

KAZUO MATSUMOTO and HIDEJI OZAWA (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. S-1 to S-6. In Japanese.

The operation and utilization systems of the Japanese experiment module (JEM) are presented. The flow chart of the JEM system is presented and payload integration and crew member training are emphasized. Y.P.Q.

A92-35604

THE JAPANESE EXPERIMENT MODULE (JEM) OPERATIONS ASSOCIATED WITH THE TRAINING OF ASTRONAUTS

YOSHIYUKI HASEGAWA (NASDA, Tokyo, Japan), K. UENO, and HIDEJI SUMINAMI (Manned Space Systems, Inc., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 3, 4. In Japanese.

The introduction of the astronauts training program of the Japanese Experiment Module (JEM) are presented. The JEM operational training systems both at the Tsukuba Space Center, Japan and at the Johnson Space Center are discussed. The simulation training equipment is described. Y.P.Q.

A92-35639

STUDY ON HIGH VELOCITY PROJECTILE FACILITIES

YUJIRO HAKUI and M. TOYAMA (Mitsubishi Electric Corp., Kamakura, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 81, 82. In Japanese. refs

The structural designs of high velocity projectile facilities in connection with research on the protection against space debris are presented. The performances of different kinds of hypersonic projectile facilities such as a one-stage powder gun, a two-stage light gas gun, and a rail gun are introduced. Y.P.Q.

A92-35641

CURRENT STATUS AND FUTURE TASKS OF RADAR OBSERVATION TECHNOLOGY FOR SPACE DEBRIS

TORU SATO (Kyoto University, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 87, 88. In Japanese. refs

The radar observation technology for space debris is described.

The configurations and performance of the Long Range Imaging Radar (LRIR) are introduced. The functions of MU-radar for the observation of space debris are outlined. Y.P.Q.

A92-35645

DEVELOPMENT OF AN AUTOMATIC SAMPLE EXCHANGER FOR MATERIALS TESTS

KENICHIRO YATSUYA, MITSU TRUMURA, KENICHI KAWAZOE, T. KOZUKA, NORIO MIZUNO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and NOBORU WAKASUGI (Institute for Unmanned Space Experiment Free Flyer, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 95, 96. In Japanese.

The configurations and performance of an automatic sample exchanger for materials tests are presented. The characteristics of the exchanger are given and the technological problems are discussed. Y.P.Q.

A92-39282

A GROUND TEST EQUIPMENT WITH SUSPENSION WIRES FOR ADAPTIVE STRUCTURES

SABURO MATUNAGA (Tokyo, University, Sagamihara, Japan) and MICHIOHITO NATORI (Institute of Space and Astronautical Science, Sagamihara, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 917-927. refs Copyright

A new concept for the gravity compensation of space structures including especially adaptive structures is proposed. Test equipment using this concept has the ability to actively follow the motion of structure by using movable units and by sensing the inclinations of the suspension wires. The main frame of the test equipment is able to rotate. The rotational degree of freedom is needed in order to simulate the rotational rigid body movement and to avoid the collision between neighboring movable units. Some results of a geometrical analysis and computational simulations to confirm the validity of the rotational degree of freedom are shown, and the outline of the equipment hardware is briefly introduced. Author

A92-43117

STUDY ON THE CONCEPT OF SPACE FLIGHT SIMULATORS

AKIRA WATANABE (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 116-119. In Japanese. refs

A classification for the simulated environment of space flight simulators is presented. The utilization of the simulator is described, with emphasis on evaluations of flight control and stability, guidance and navigation, space operation environment and remote control, and astronaut training. The structures of different space flight simulators are described. Y.P.Q.

A92-43192

WIND TUNNEL TESTS ON THE MOTION OF A SPACEPLANE SIMULATION FOR CABLE MOUNT

MASAHICO NAGAYASU, SEIZO SUZUKI, SHUICHI SASSA (National Aerospace Laboratory, Tokyo, Japan), and K. YONEMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 432-435. In Japanese. refs

The structures of the cable mount system (CMS) for a spaceplane is presented. The control measuring system and interactive parameter identification system are illustrated and wind tunnel dynamic test is discussed. Test results are given and aerodynamic microcoefficients are listed. Y.P.Q.

A92-43193

POSITION MEASUREMENT ON A MOTION MODEL WITH A VIDEO TRACKING SYSTEM

SEIZO SUZUKI, M. NOGUCHI, and KATSUICHI MUROTA (National

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Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 436-439. In Japanese. refs

A three-dimensional position measuring instrument called 3DVPM for the measurement of center of gravity position and azimuth of a spaceplane is presented. Features of the 3DVPM are discussed, including the video tracking system and the controller. Measurement accuracy is evaluated, and test results are reported. Y.P.Q.

A92-43300

GROUND VERIFICATION FOR HIGH-ACCURACY ON-BOARD ANTENNA DRIVE CONTROL SYSTEM

HIROSHI TANAKA and YOICHI KAWAKAMI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 1. San Diego, CA, Univelt, Inc., 1992, p. 839-855. refs (AAS PAPER 91-487) Copyright

Ground-verification techniques are discussed that can be used for predicting the control characteristics of an antenna drive-control system (ADCS) while compensating for antenna pointing error. The ADCS functions and operating environment are considered to determine the ground-test system configuration and gravity-compensation method. A laser-measurement system is employed to detect rotation of the antenna pointing mechanism (APM), and adjustments to the wire tension and the location of the suspension point are used for gravity compensation. A closed-loop test system is designed with a laser ray, and an RF converter is used to simulate RF characteristics. The simulated error for pointing-error sensitivity can be suppressed to within 10 percent, and the update time of the RF converter is 0.005 seconds. The verification methods can be used to effectively evaluate the ADCS control characteristics when the antenna reflector is controlled by a pointing mechanism and a beacon signal. C.C.S.

A92-50572

TEST FACILITY OF THERMAL STORAGE EQUIPMENT FOR SPACE POWER GENERATION

T. INOUE, M. NAKAGAWA, Y. MOCHIDA, F. OHTOMO, K. SHIMIZU (Toshiba Corp., Kanagawa, Japan), K. TANAKA, Y. ABE, O. NOMURA, and M. KAMIMOTO (Electrotechnical Laboratory, Tsukuba, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 1. La Grange Park, IL, American Nuclear Society, 1991, p. 308-312. refs Copyright

A thermal storage equipment test facility has been built in connection with developing solar dynamic power systems (SDPSs). The test facility consists of a recuperative closed Brayton cycle system (CBC), with a mixture of helium and xenon with a molecular weight of 39.9 serving as the working fluid. CBC has been shown to be the most attractive power generation system among several types of SDPSs because of its ability to meet the required high power demand and its thermal efficiency, about 30 percent. The authors present a description of this test facility and give results of the preliminary test and the first-stage test with heat storage equipment. I.E.

A92-53631

A LABORATORY ELECTROMAGNETIC ACCELERATOR AND ITS ANALYSIS BY THE HYBRID FINITE ELEMENT AND BOUNDARY ELEMENT METHOD

TAKASHI ONUKI, ATSUSHI ISHIYAMA, and KENJI SATO (Waseda University, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1291-1296. refs Copyright

A hybrid FEM/boundary-element method is presently used to analyze a laboratory-scale linear-induction accelerator (LIA), in conjunction with a novel numerical method for EM field calculations.

Attention is given to the flux distribution and transient switch-on thrust. Magnetic flux density increases at the front and rear ends of the system's secondary, due to the end effect. A comparison of analytical and experimental results shows the method to be suitable for short-secondary LIAs. O.C.

A92-53706

CONCEPTUAL STUDY ON LUNAR OUTPOST

TAKAO ETO, TSUTOMU IWATA, YUTAKA KANEKO, and TOSHIHIDE MAEDA (NASDA, Tsukuba Space Center, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1817-1822. refs Copyright

The manned Lunar 'Outpost' envisioned by Japan's NASDA represents the minimum basis for the support of a human presence for short periods of time, and constitutes a first-decade-of-21st-century precursor for eventual lunar bases by conducting experiments on the use of lunar surface resources. The modules of the Lunar Outpost are transported to the lunar surface in the vicinity of the eastern edge of the lunar equator; crewmembers will be sent on a second vehicle. The Outpost will maintain three crewmembers for 10 to 15 days; both lunar resource utilization and astronomical/astrophysical observations can be conducted in this time. O.C.

A92-53707

EXCAVATION AND ROCK BREAKING SYSTEM ON THE MOON

KATSUNORI SHIMIZU (Shimizu Corp., Technology Div., Tokyo, Japan), TETSUJI YOSHIDA (Shimizu Corp., Tokyo, Japan), YOSHIRO KAI (Shimizu Corp., Nuclear Power Div., Mita, Japan), HIDEYUKI MANO (Shimizu Corp., Institute of Technology, Tokyo, Japan), KENJI TAKAGI, and SHINJI MATSUMOTO (Shimizu Corp., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1823-1829. Copyright

The construction of lunar bases underground, in order to escape cosmic rays and small meteorites, entails lunar regolith soil-excitation equipment capable of both rock fracture and the subsequent processing of the mineral detritus from excavation sites. Consideration is given to excavation systems' power supplies, heat removal, mechanical bearings, vehicular platform, conveyor belts, and tool accessories. An evaluation is made of the enabling technologies required for such devices' implementation. O.C.

A92-53708

A COST STUDY OF CONCRETE UTILIZATION ON THE MOON

HIROSHI KANAMORI, HARUO FUJISHIRO, KOU YATSUYANAGI, and SHINJI MATSUMOTO (Shimizu Corp., Institute of Technology, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1831-1836. refs Copyright

So far, a lot of material processing systems to be operated on the moon have been proposed. These materials to be produced include various alloys, glass, ceramics, concrete and so on, and are expected to be applied to various construction materials, such as main structural matrices, reinforcements, and adhesives. However, it is necessary to evaluate these materials from an economic point of view, because expensive materials will be eliminated, even if they are technically proved to be producible on the moon. A cost model is formulated, and the production systems for concrete and steel are numerically analyzed. Based on the analysis, the costs of concrete, steel, and aluminum are estimated and compared. As a result, it is expected that the concrete cost would be almost the same as the steel cost on the moon, and these costs would be much lower than the cost of aluminum imported from earth. Therefore, it is concluded that a steel reinforced concrete will be a realistic construction material.

Author

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A92-53710

PRELIMINARY CONCEPT FOR UNMANNED LUNAR ROVER MISSIONS

TSUTOMU IWATA, YUTAKA KANEKO (NASDA, Tsukuba, Japan), HIROHITO HIRA, TEIJI TAJIMA, HIDEO SUDOH, and SENJI NIWA (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1845-1852. refs
Copyright

An unmanned lunar rover mission is presently envisioned for lunar resource surveying and the proof-of-concept testing of manned lunar bases and manufacturing plant. The key lunar rover technology features identified by the present NASDA study encompass the ability to handle small lunar reolith particles, capabilities for liquid/solid reaction phase control, cryogenic distillation of He-3, and the mass-spectroscopic distillation of He-3, as well as compact and long service-life processing equipment designs. O.C.

A92-53711

UNMANNED LUNAR LANDER AND MOBILE EXPLORER

TSUTOMU IWATA, TAKAO ETO, and YUTAKA KANEKO (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1853-1858. refs
Copyright

Robotic precursor missions are envisioned as low-cost/low-risk efforts prior to manned efforts at lunar base construction. An account is given of the results of a conceptual study on the lunar lander craft and the lunar mobile explorer vehicle required for respectively transporting 0.9 tonnes of payload to the moon with a cryogenic fuel descent engine and the requisite lunar surface movements on the basis of one solar cell array and a chemical battery. The lunar explorer is a six-wheeled vehicle with sample manipulators. O.C.

A92-57160

OVERVIEWS ON THE JAPANESE ACTIVITIES ON PLANETARY ROVERS

TSUTOMU IWATA (NASDA, Tsukuba Space Center, Japan) and ICHIRO NAKATANI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p.
(IAF PAPER 92-0736) Copyright

Two lunar rovers and a Mars rover being studied in Japan are presented. All of them are unmanned semiautonomous rovers taking advantage of robotic technologies on the ground. One of the lunar rovers is a mission dedicated to science observation and is compatible with M-V launch vehicle and weighs 208 kg. The other is compatible with H-II launch vehicle and weighs 900 kg. The Mars rover presented here is for science mission and weighs 1,790 kg. One of the main missions is drilling deep into the Mars surface for studying the surface materials. Author

A92-57183

INFLATABLE LUNAR STRUCTURE WITH REINFORCING RINGS - SELF-SHAPING AND SELF-SINKING SYSTEM FOR LUNAR BASE

SHINJI MATSUMOTO, JUNJI SASAKI, TETSUO SAITO, TAKANORI SATO, KENJI NOZAKI, YOSHIRO KAI, HIROSHI KANAMORI, KENJI TAKAGI, HIROSHI UENO, HARUO NAKAZAWA (Shimizu Corp., Tokyo, Japan) et al. IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p. refs
(IAF PAPER 92-0768) Copyright

New concepts of construction techniques for the earliest stage of a lunar outpost are presented, focusing on self-shaping and self-sinking structures. The objective of this study is to plan for early-stage, already-pressurized, and ready to use facilities. Consideration is given to a low-cost construction system for future

lunar facilities employing autoconstruction principles and self-shaping inflatable structure concepts. R.E.P.

N92-20725# National Space Development Agency, Tokyo (Japan). Launch Operations Dept.

H-2 ROCKET LAUNCH BASE

SUMIO MIIDA and TOMOTSUGU OHNISHI IN ESA, Launch Bases and Control Infrastructures for Spacecraft p 57-61 Oct. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

With the advent of a new space era, NASDA is to launch a full scale rocket, H-2, that will be a major Japanese launch vehicle in years to come. The launch facilities for the H-2 are being installed and built in Tanegashima Space Center (TNSC). Those facilities, accommodating spacecraft launch operations, are described. Some operation outlines are shown. The content is not necessarily accurate at this point, since the project is still developing. ESA

N92-20738# Tokyo Univ., Sagami-hara (Japan). Inst. of Space and Astronautical Science.

FLIGHT SAFETY AND GUIDANCE PROCEDURE IN KAGOSHIMA SPACE CENTRE (JAPAN)

MOTOKI HINADA (Tokyo Univ., Sagami-hara (Japan).), H. MATSUO (Tokyo Univ., Sagami-hara (Japan).), Y. MATOGAWA (Tokyo Univ., Sagami-hara (Japan).), TAKASHI NAKAJIMA (Tokyo Univ., Sagami-hara (Japan).), S. TSUKAMOTO (Tokyo Univ., Sagami-hara (Japan).), Y. MAEDA (Tokyo Univ., Sagami-hara (Japan).), and M. KURIHARA (Fujitsu Ltd., Tokyo, Japan) IN ESA, Launch Bases and Control Infrastructures for Spacecraft p 133-137 Oct. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

The Institute of Space and Astronautical Science (ISAS), the center of the research for space and astronautical science in Japan, has developed a series of satellite launchers called Mu series for its own missions. Since the first launch in 1971, five engineering test satellites and thirteen scientific ones, including two interplanetary ones, have been successfully launched from Kagoshima Space Center (KSC). The launch site of ISAS, KSC, is located in the southern part of Japan and, when the azimuth of the launch vehicle is set to 90 degrees measured from north, the deviation of the flight path of about 15 degrees may cause a hazardous situation, since there are very crowded areas under such a path in Japan. And, when the flight safety manager judges the necessity of the flight safety operation, the destruction command will be transmitted to the vehicle to stop its further flight. The principle of the flight safety and guidance procedure and system applied for Mu launch vehicle is presented. ESA

N92-20743# National Space Development Agency, Tokyo (Japan).

FLIGHT SAFETY SYSTEMS FOR THE H-2 LAUNCH VEHICLES

HIDEHIKO MORI, S. ISHIDA, and T. SATO IN ESA, Launch Bases and Control Infrastructures for Spacecraft p 163-168 Oct. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 guilders

The H-2 rocket, Japan's new expandable launch vehicle, is under development by NASDA (National Space Development Agency of Japan) and is to be operational in 1993. The fundamental policies of flight safety practiced by NASDA and newly developed flight safety systems for the H-2 rocket are described. Due to limited land space in Japan, the flight safety immediately following the liftoff is a very important consideration. Launch site, RCC (Range Control Center) and other facilities are being built in new locations. In addition, construction of the flight safety systems for the H-2 rocket is taking place. Computers and displays are being renewed for flight safety observation systems. Communication systems are also being reconstructed using optical local area network system. ESA

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N92-22092# National Space Development Agency, Tokyo (Japan). Environmental and Structural Test Dept.

SPACECRAFT INTEGRATION AND TEST FACILITIES AT TSUKUBA SPACE CENTER

SENIRO IIDE and MITSUHIRO TSUCHIYA *In its* Preprints of NASDA's 5th Technical Symposium p 65-89 1 Jun. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A03

In order to perform the development test of large scale test objects such as large satellites, manned space station, space planes, and so on, launched on the H-2 Rocket, the National Space Development Agency of Japan (NASDA) built the Spacecraft Integration and Test Building (SITE) during fiscal years 1986 and 1989. An outline of the constructing details and the specifications of these test facilities are presented, and the operating situation after construction including results of the facilities' test data are provided. Author (NASDA)

N92-24512# Mitsubishi Electric Corp., Amagasaki (Japan). Central Research Lab.

DEVELOPMENT OF A HYBRID DOCKING DYNAMICS SIMULATOR

MASAO INOUE (Mitsubishi Electric Corp., Amagasaki (Japan).), JUN NAKAGAWA (Mitsubishi Electric Corp., Amagasaki (Japan).), and NAOMI ARIMA (Mitsubishi Electric Corp., Kamakura, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 601-606 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

In order to evaluate the performances of automatic rendezvous and docking system, a hybrid motion simulator was developed. The relative motion of the spacecraft after collision was realized in real time by a computer controlled moving table in which real docking hardware were exposed to the target. The mechanical configuration, computer architecture and the simulation algorithms are described. To make the system reliable, a dual Digital Signal Processing (DSP) card and delay compensation are introduced. Several docking tests prove the simulator to be a powerful tool for designing docking systems. ESA

N92-25624# National Space Development Agency, Ohashi (Japan). ERS-1 Payload Ground Segment Office.

ERS-1 FACILITY AT EARTH OBSERVATION CENTER

HIROYUKI WAKABAYASHI *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 29-40 2 Nov. 1990

(EW-4) Avail: CASI HC A03/MF A02

Presented in viewgraph format, the status and overview of JERS-1 (Japan Earth Resources Satellite-1) ground system are outlined. Topics addressed include: purposes and functions of JERS-1 ground system; system overview; development schedule; functional block diagram of JERS-1 ground system; ground station; data receiving system; data recording system; data processing system; quality of JERS-1 data; and flow of SAR (Synthetic Aperture Radar) data processing. Author (NASDA)

N92-25627# Alaska Synthetic Aperture Radar Facility, Fairbanks.

ALASKA SAR FACILITY

JOHN MILLER *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 71-81 2 Nov. 1990

(EW-7) Avail: CASI HC A02/MF A02

Presented in viewgraph format, the data system of ASF (Alaska Synthetic Aperture Radar Facility) in the U.D. is outlined. Topics addressed include: functional block diagram of ASF and its mission planning subsystem; SAR (Synthetic Aperture Radar) data processing system of ASF; system architecture of SPS (SAR Processor System); ASF data products; geophysical data processing system; ice motion tracking system; and image analysis system. Author (NASDA)

N92-25628# Canada Centre for Remote Sensing, Ottawa (Ontario). Data Acquisition Div.

STATUS OF CANADIAN GROUND STATIONS

LEON BRONSTEIN *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 83-90 2 Nov. 1990

(EW-8(1)) Avail: CASI HC A02/MF A02

Presented in viewgraph format, ground stations of CCRS (Canada Centre for Remote Sensing) in Canada are introduced. Topics addressed include: functional block diagram of Canadian ERS-1 ground segment; data acquisition facilities; data transfer network; SAR (Synthetic Aperture Radar) data processing facility; satellite systems and operations of CCRS; plans of satellite signal reception in CCRS; and plans of JERS-1 (Japan Earth Resources Satellite-1) data processing. Author (NASDA)

N92-25631# National Research Council, Bangkok (Thailand).

JERS-1 WORKSHOP ON THE GROUND STATION FOR ASEAN

CHANCHAI PEANVIJARNPONG *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 101-112 2 Nov. 1990

(EW-10) Avail: CASI HC A03/MF A02

Presented in viewgraph format, the present status of the ground station and future plan for utilizing earth observation satellites in Thailand is outlined. Topics addressed include: data acquisition system; operation status of LANDSAT, SPOT, and MOS-1 (Marine Observation Satellite-1); remote sensors of satellites; data output form; data correction level; data system in Thailand; ground station for MOS-1 satellite in Thailand; and future plan. Author (NASDA)

15

LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

A92-12551

STUDY OF FIRE-IN-THE-HOLE SYSTEM FOR M-V LAUNCH VEHICLE

TAKASHI NAKAJIMA, YOSHIFUMI INATANI, HIROKI MATSUO, MOTOKI HINADA, RYOJIRO AKIBA, HIDEO MARUTA (Institute of Space and Astronautical Science, Sagami-hara, Japan), AKISATO TAKAHASHI, and NOBORU ONOJIMA (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs (IAF PAPER 91-172) Copyright

The M-V launch vehicle, which represents the next generation of the Mu series, is currently under development by the Institute of Space and Astronautical Science, and the first one is planned for launch in early 1995. The M-V is designed to have the capability to launch about 2 tons of payload into LEO. In order to increase this capability, some challenges have had to be met. The first of these is in the design of staging system for the first and second stages, which takes into account that the second stage motor needs to be ignited before the burn-out of the first stage motor; that is, a system termed the 'Fire-in-the-Hole' (FITH) is going to be adopted. This paper describes the concept of a FITH staging system for the M-V which will reduce the inert weight of the second stage and allow safe separation with sufficient staging clearance. It also presents some results on experiments to estimate pressure and heat flux distributions caused by exhaust gas of the second stage and forces acting on the first stage. Author

A92-12595

STATIC FIRING TEST RESULTS OF THE H-I AND H-II LAUNCH VEHICLE DEVELOPMENT AT THE TANEGASHIMA SPACE CENTER

RYUICHI SEKITA, YOSHITAKA HARAGUCHI (NASDA, Tanegashima Space Center, Kagoshima, Japan), AKIRA KONNO,

15 LAUNCH VEHICLES AND SPACE VEHICLES

and TAKASHI SAITO (NASDA, Propulsion Engineering Group, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs (IAF PAPER 91-264) Copyright

In addition to its H-I launch vehicle complex, Japan's Tanegashima Space Center (TSC) encompasses three static-firing test facilities. These facilities will respectively be used in the course of the H-II launch vehicle development program for the static firing of strap-on boosters, the MB-3 liquid-fueled engine, and the Yoshinobu static firing test facility for the LE-7 staged combustion-cycle first-stage engine. Results are presented from static firings for the three H-II components which have been conducted to date. The first flight of the H-II, following completion of static tests at the aforementioned TSC facilities, is scheduled for 1993. O.C.

A92-12599

ADVANCED SCRAM-LACE SYSTEM CONCEPT FOR SINGLE-STAGE-TO-ORBIT SPACE PLANE

Y. MIKI, M. TOGAWA, T. TOKUNAGA (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), K. EGUCHI, and T. YAMANAKA (National Aerospace Laboratory, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs (IAF PAPER 91-272) Copyright

The paper describes a conceptual design of a propulsion system for a 350 MG spacecraft, which is considered a most promising propulsion system for realizing a lightweight reusable SSTD vehicle. The system consists of a scramjet engine with thermal energy recovery from the aerodynamically-heated vehicle and a tank-return cycle liquefied-air-cycle engine (LACE) with an air compressor. A schematic diagram illustrating SCRAM-LACE propulsion is included along with data illustrating the performance of LACE and scram propulsion cycles. I.S.

A92-12614

SEPARATION JETTISON TEST OF H-2 ROCKET SATELLITE FAIRING

Missiles and Spacecraft (ISSN 1001-4144), June 1991, p. 27-31.

The design and performance of the Japanese H-2 rocket fairing are presented. Separation and jettison tests of the fairing are discussed. The process, methods, and test equipment are introduced, and the test results are analyzed. Y.P.Q.

A92-17810#

SYSTEM STUDIES ON SSTD SPACE PLANE

MASATAKA MAITA (National Aerospace Laboratory, Chofu, Japan), TAKASHIGE MORI (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan), and YOSHIKI OHKAMI (Tokyo Institute of Technology, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 10 p. refs (AIAA PAPER 91-5012) Copyright

A summary of current activities on SSTD spaceplane studies in Japan is presented. Emphasis is placed on system studies of an SSTD vehicle powered by a hypersonic airbreathing propulsion system. Attention is given to parametric analyses of the effects of hypersonic airbreathing engine performance, i.e., the engine's acceleration limit, the flight trajectory, the vehicle's weight, and drag reductions on system feasibility. R.E.P.

A92-17860#

WEIGHT REDUCTION TECHNOLOGY FOR SPACE PLANE STRUCTURES

H. KIKUKAWA (Fuji Heavy Industries, Ltd., Utsunomiya, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 10 p. refs (AIAA PAPER 91-5097) Copyright

The construction of an SSTD aerospace plane is analyzed for feasibility in the light of advanced materials and structural design concepts for weight reduction. Weight-reduction technologies are assessed in terms of quantitative predictions of weight loss when the technology is incorporated. Concepts are reviewed such as

the honeycomb integral tank, aeroelastic tailoring, advances in landing gear, and propulsion-system technology, and weight-reduction assessments are made. A structural weight-fraction target of 15 percent is identified for an SSTD aerospace plane, and two estimates are made for similar vehicles. Three composite-material technologies are incorporated with five design concepts into the SSTD configuration in an attempt to match the desired weight fraction. The advanced materials permit significant weight savings over conventional Al construction, and the weight-reduction technologies impose considerable constraints on the final configuration. C.C.S.

A92-18485

FUTURE EARTH-MOON TRANSPORTATION SYSTEM FOR MANNED LUNAR BASE PROJECT - STUDY OF LOW COST CONFIGURATION

TORU TANABE and SHINICHI NAKASUKA (Tokyo, University, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 12 p. Research supported by Institute for Future Technology of Japan. refs (IAF PAPER 91-441) Copyright

Low-cost configuration of earth-moon space transportation system for a specific lunar base project is studied. The transportation system consists of launchers, OTVs, moon landers, and other infrastructures, and the combination of the variety, type, size and number of these elements is searched for which yields the most cost-effective transportation service for the several assumed mission models. Since the search space for the least cost combination will be quite huge because of the large number of design parameters and their mutual interactions, a systematic approach is employed to reduce the search space. Space fuel stations on LLO or LEO are also studied in terms of its effect on total system cost, and it is indicated that LEO fuel station will sufficiently reduce the total system cost under large mission size. As a result of these studies, a new space transportation scheme is proposed which employs LEO fuel station and reusable OTVs. Several technical issues for the realization of this scheme are discussed as well. Author

A92-18570

SAFETY OPERATION EXPERIMENT FOR M-V LAUNCH VEHICLE

T. NAKAJIMA, M. HINADA, R. AKIBA, M. KOHNO, Y. MATOGAWA, and N. ISHII (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 5 p. refs (IAF PAPER 91-582) Copyright

Safety Operation Experiment was executed using the SO-520 motor which is the simulation motor of the 1st stage of the M-V launch vehicle. Since 1970, the Institute of Space and Astronautical Science has successfully launched twenty scientific satellites by the Mu Launch Vehicle, which is a solid fueled launch vehicle, and the M-V, the next generation of Mu family, is under development. In the launching phase, there is a possibility of the destruction of the launch vehicle by the command from the ground station when the hazardous situation would be foreseen. That is usually called the Safety Operation (SO). SO-520 Motor was ignited and, after thirteen seconds, the chamber was split by the linear-shaped charge installed on the symmetrical position of the motor case in parallel. The distribution of the scattered solid propellant was measured where the ballistic coefficient is a parameter, and the blast, acoustic, elastic, and seismic waves were measured. The experiment was optically monitored and recorded. Analytical method for predicting the maximum range of the scattered propellant fragments was presented and it was confirmed that it is a useful method for that purpose. Author

A92-22631

ON THE HIMES WINGED SPACE VEHICLE

MAKOTO NAGATOMO, YOSHIFUMI INATANI, YOSHIHIRO NARUO, and JUN'ICHIRO KAWAGUCHI Japan Society for Astronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 565-570. In Japanese. refs

15 LAUNCH VEHICLES AND SPACE VEHICLES

The concept and development of the HIMES (Highly Maneuverable Experimental Space Vehicle) winged space vehicle are presented. Research on the aerodynamics, control, structure, and propellant systems is discussed. Y.P.Q.

A92-22632

SPACEPLANE SYSTEM STUDIES

MASATAKA MAITA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 571-579. In Japanese. refs

Basic system concepts of Japanese spaceplane research and development are presented. The single stage to orbit system of the spaceplane is illustrated. The hypersonic airbreathing propulsion system is addressed. Y.P.Q.

A92-22633

SPACEPLANE FLIGHT DYNAMICS

KANICHIRO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 580-585. In Japanese. refs

The flight characteristics of the spaceplane are discussed including speed and altitude. Motion equations of the spaceplane are given, and the guidance and control systems are presented. Y.P.Q.

A92-22637

RESEARCH ON A STRUCTURAL CONCEPT FOR THE HEAT-RESISTANT AIRFRAME OF HOPE

MASATAKA YAMAMOTO, TADASHI MATSUSHITA, HIDEHIKO MITSUMA, and MOTOHIRO ATSUMI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 609-614. In Japanese. refs

The structural design and thermal protection of HOPE (H-II Orbiting Plane) are presented. The characteristics of appropriate heat-resistant materials are compared, and the thermal protection design is analyzed. Y.P.Q.

A92-24910

HOPE LOOKS TO CFD FOR HELP

YUKIMITSU YAMAMOTO, SATORU OGAWA, and SUSUMU TAKANASHI (National Aerospace Laboratory, Tokyo, Japan) Aerospace America (ISSN 0740-722X), vol. 30, Feb. 1992, p. 39-41.

Copyright

The Japanese National Aerospace Laboratory's H-II Orbiting Plane ('HOPE'), currently under development, makes intensive use of CFD techniques in virtue of the impossibility of simulating real-gas effects with ground-based hypersonic experimental facilities. CFD can calculate the complete hypersonic real-gas flowfield around HOPE via chemically nonequilibrium Navier-Stokes codes, with all due attention to air dissociation and ionization over the entire vehicular surface. O.C.

A92-26846

TROPICAL RAINFALL MEASURING MISSION (TRMM) PROJECT. VI - SPACECRAFT, SCIENTIFIC INSTRUMENTS, AND LAUNCHING ROCKET. PART 5 - H-II ROCKET FOR TRMM

YOJI SHIBATOH and HIROMICHI YAMASAKI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 11, June 1990, p. 107-111. In Japanese.

The H-II rocket is being developed as the main launch vehicle of NASDA for the 1990s. The H-II launch vehicle consists of cryogenic first and second stages of 4 meters in diameter and a pair of strapped-on solid rocket boosters. The two-stage configuration and the second stage restart capability make it a versatile launcher capable of fulfilling a wide range of missions including multisatellite launches. These characteristics of the H-II provide the capability for launching the TRMM satellite effectively where the mission orbit is a circular orbit at 350 km. The TRMM satellite can be launched simultaneously with a geostationary satellite. Author

A92-38719#

H-II SOLID ROCKET BOOSTER DESIGN AND DEVELOPMENT
YUKIO FUKUSHIMA, TAKESHI FUJITA (NASDA, Tokyo, Japan), and MASANORI NAGATOMO (NASDA, Washington, DC) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 8 p. refs
(AIAA PAPER 92-1659) Copyright

The development of SRB has been started with the basic test on the conceptual design and components of the solid rocket motor (SRM) in 1985. At present, the development tests of SRB were completed with the successful static firing test of Qualification Model (QM), the last of four full size test models. Flight motors and the booster subsystem are currently being fabricated. This paper presents the SRB design and its system description. The development test results are also reviewed. Author

A92-43190

FLIGHT SIMULATION OF A SPACEPLANE

S. SUZUKI, T. KANDO, and S. TORINOUMI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 424-427. In Japanese. refs

A theoretical study of a spaceplane is presented, with emphasis on the aerodynamic characteristics. Simulation results are given and the effectiveness of airframe shapes is analyzed. Y.P.Q.

A92-43200

TRANSONIC VISUALIZATION TEST FOR THE AIRFRAME SHAPE IMPROVEMENT OF A SPACEPLANE

S. SAYA, MAMORU SATO, H. KANDA, and S. BABA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 464-467. In Japanese. refs

A visualization test for spaceplane shape improvement is presented. The wind tunnel test and its test method are introduced. The basic and improved configurations of the test model are described. Y.P.Q.

A92-43211

ESTIMATION OF SPACEPLANE LONGITUDINAL STABILITY AND CONTROL DERIVATIVES FROM DYNAMIC WIND TUNNEL TEST

MASAAKI YANAGIHARA, SHUICHI SASA, TAKASHI SHIMOMURA, MINORU TAKIZAWA, SEIZO SUZUKI, and MASAHICO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 508-511. refs

Dynamic wind tunnel tests using a 5-percent cable-mounted model of the NAL spaceplane have been conducted in the NAL low-speed large scale wind tunnel. A parameter identification study of the recorded data was undertaken to extract longitudinal stability and control derivatives. The following three estimation methods were adopted: (1) estimate all the derivatives simultaneously; (2) estimate the stability and control derivatives separately; and (3) estimate the dynamic derivatives only while the static derivatives are fixed in results from static wind tunnel tests. The estimated derivatives were evaluated by comparing mathematically simulated time histories based on them with tunnel test data. As a result, all major derivatives were estimated well and the effectiveness of the dynamic test was shown. Author

A92-43212

ESTIMATION OF SPACEPLANE MODEL INERTIA CHARACTERISTICS

MASAAKI YANAGIHARA, SHUICHI SASA, TAKASHI SHIMOMURA, and MASAHICO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 512-515. refs

The moments and product of inertia of a NAL spaceplane 5-percent model have been determined experimentally. The method

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was based on a bifilar pendulum system, and estimation errors were also evaluated. As a result, the moment of inertia I_y and I_z were estimated within the error of about 1 percent but I_x and the product of inertia I_{xz} had larger errors. The largest cause for these errors is that the moment of inertia of a suspension rig about the x axis is relatively large compared with that of the model. Author

A92-43235

A HEAT-RESISTANT ANTENNA FOR HOPE

TOSHIO ONO, T. OZAKI, and T. TAKADA (Mitsubishi Electric Corp., Sagami-hara, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 604-607. In Japanese.

The heat-resistant antenna system for HOPE (H-II orbital plane) is presented. Requirements on the structural materials and heat protection materials for the HOPE antenna system are discussed. Calculations of the surface temperature are presented. Y.P.Q.

A92-48895#

STATUS OF THE 1990'S JAPANESE SOLID ROCKET PROGRAMS

MASAHITO KOHNO (Institute of Space and Astronautical Science, Sagami-hara, Japan) and YUKIO FUKUSHIMA (NASDA, Tokyo, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 8 p. refs (AIAA PAPER 92-3307) Copyright

This review examines the development of launch vehicles and related technologies in Japan with attention given to applications of the programs. Descriptions are given of current vehicles, their applications, and specific design considerations including those for the M-3SII and the H-I. Vehicles under development include the two-stage H-II for sending two-ton payloads into GEO. Also described are: (1) the TR-1A for 750 kg of payloads for microgravity experiments; (2) the J-I three-stage all-solid vehicle; and (3) the M-V three stage all-solid vehicle for larger payloads. The H-II is shown to be a prime candidate for use as a workhorse in the deployment of satellites for communications and remote sensing, and the H-II is intended for use in development of space stations. The M-V is expected to provide the means for deploying precursor lunar/planetary exploration spacecraft. C.C.S.

A92-51699

JAPAN DEVELOPING NEW SOLID BOOSTERS

PAUL PROCTOR Aviation Week & Space Technology (ISSN 0005-2175), vol. 137, no. 6, Aug. 10, 1992, p. 47-49. Copyright

A review is presented of Japan's continuing development of its space launch capability with two new solid-fuel boosters for carrying lightweight payloads, including scientific satellites. Combined with Japan's new H-2 heavy-lift booster the two new rockets, the J-1 and M-5, will provide an all-new booster lineup, with future developments to further increase rocket performance and provide a wider, more efficient range of booster-to-payload matchups. R.E.P.

A92-53471

PRELIMINARY BATTLESHIP TANK FIRING TEST OF H-II LAUNCH VEHICLE FIRST STAGE

MASAHITO MORI, HIROO KAZAMA, HIROYUKI NAKATSUJI (NASDA, Tokyo, Japan), ISAO YAMAZAKI, TAKASHI MAEMURA, and MASAHITO ATSUMI (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 145-151. Copyright

The development, objectives, facilities, and results of a preliminary battleship tank firing test series of the first stage propulsion system of the H-II rocket are discussed. The test series included two engine chilldown tests and 12 short-duration hot firing tests. The results verify the basic compatibility of the tank system and the LE-7 engine. C.D.

A92-53472

BATTLESHIP TANK FIRING TEST OF H-II LAUNCH VEHICLE SECOND STAGE

MASAHITO MORI, HIROO KAZAMA, HIROYUKI NAKATSUJI (NASDA, Tokyo, Japan), ISAO YAMAZAKI, HIROSHI MAEKAWA, and TOSHIHIKO NAKAGAWA (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 153-158. Copyright

The objectives, facilities, articles, and results are presented of a series of battleship tank firing tests on the second stage propulsion systems of the H-II launch vehicle. The test series included 11 hot firing tests under first burn conditions, restart conditions, and idle mode conditions. Oscillatory perturbations were added to the LOX flow in some cases to obtain data concerning POGO oscillation. The results verify the functions of the second stage propulsion system. C.D.

A92-53484

CONCEPTUAL STUDY OF THE MOVABLE NOZZLE TVC SYSTEM FOR M-V LAUNCH VEHICLE

MASAHITO KOHNO, JUNICHIRO KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan), TATSURO ASAI, NOBORU ONOJIMA, and SHUNICHI OKAYA (Nissan Motor Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 243-248. Copyright

A thrust vector control (TVC) concept involving a movable nozzle for the M-V launch vehicle is described. The TVC system development schedule is shown. C.D.

A92-53521

GENERAL STRUCTURAL ANALYSIS OF AN UPPER STAGE COMPOSITE ROCKET MOTOR CASE

KURT GRAMOLL (Institute of Space and Astronautical Science, Sagami-hara, Japan), FUMIHARU NAMIKI (Nissan Motor Co., Ltd., Aeronautical and Space Div., Tokyo, Japan), and JUNJIRO ONODA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 519-526. Research supported by MOESC, NSF, and Japan Society for the Promotion of Science. refs Copyright

The design and structural analysis methods for a 1.5 m diameter upper stage filament wound composite rocket motor case are presented. The basic dome contours were designed using netting theory, however, nonlinear finite element method was used to refine the design and to predict final fiber stresses. This study found that polar bosses with large flanges can reduce the peak fiber stress near the dome opening, but oversized dome openings will adversely affect the fiber stress. Both linear and nonlinear FEM results were performed, showing the need for nonlinear analysis. A demonstration graphite/epoxy composite motor case was fabricated and tested for use in developing future composite rocket motor cases for Mu-V rocket under development at the Institute of Space and Astronautical Science (ISAS). The case has a diameter of 1.495 m and a length of 1.505 m. The case design and test results are presented. Author

A92-53526

FLUTTER ESTIMATION OF S-520 SOUNDING ROCKET FINS

MASAHISA HONDA (Nissan Motor Co., Ltd., Tokyo, Japan), JUNJIRO ONODA (Institute of Space and Astronautical Science, Sagami-hara, Japan), NOBORU ONOJIMA (Nissan Motor Co., Ltd., Tokyo, Japan), ATSUSHI NAKADA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and KOJI ISOGAI (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan,

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May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 557-562. refs
Copyright

The flutter margin of the fins, which has been improved for S-520 sounding rocket of ISAS, is estimated by wind tunnel tests and numerical flutter analysis. Both methods require stiffness distribution of the fin. In this paper, a new approach of fitting of FEM model to the measured matrix of influence coefficient is applied in order to eliminate the errors in the measured stiffness data, which may otherwise make the mathematical model nonpositive definite. The results of the wind tunnel tests and numerical flutter analysis using the above fitted FEM model stiffness distribution are compared and discussed. Author

A92-53527

A TREATMENT OF VIBRATION SUPPRESSION OF S-520 SOUNDING ROCKET

NAOYUKI WATANABE, JUNJIRO ONODA, YASUHIRO HIRATA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and KENJI KAWAI (Nissan Motor Co., Ltd., Aeronautical and Space Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 563-568.

Copyright

The S-520 sounding rocket of the Institute of Space and Astronautical Science is exposed to fairly hard mechanical environment during flight because it has a solid-propellant booster. On-board instruments at each position of the rocket are exposed to such severe vibration that they may be damaged. In the protoflight system vibration test for S-520 No.10, a payload instrument was damaged. Therefore, some treatment of vibration suppression was necessary under the constraints of the space and weight. An effective vibration suppression had been achieved by using a type of Coulomb friction damper together with changing the test method. Author

A92-53578

SPACEPLANE AERODYNAMIC HEATING AND THERMAL PROTECTION DESIGN METHOD

HIROTOSHI KUBOTA (Tokyo, University, Japan), NORIHIKO ITODA (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), KIYOSHI YAMAMOTO, and YUKIMITSU YAMAMOTO (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 915-920. refs

Copyright

At the first phase of concept design of spaceplanes, parametric studies and optimization for the various body configurations and trajectories are needed. For that purpose, the aerodynamic heating is predicted by a simple method. The wall temperature is estimated from the predicted aerodynamic heating against the various wall thickness and coolant heat transfer coefficients. A method for designing a thermal protection system is discussed. Author

A92-53600

ON THE LOAD RELIEF CONTROL IN MU LAUNCH VEHICLE

JUN'ICHIRO KAWAGUCHI, JUNJIRO ONODA, and NAOYUKI WATANABE (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 1073-1078. refs

Copyright

The simplified load relief controller, which is tuned for M-3SII vehicles, is presented. This paper focuses on the tradeoff study of both the location of lateral accelerometers and the spill-over problem. The results of the preparatory flight experiment accomplished by utilizing M-3SII-No. 5 in January 1990 are described. R.E.P.

A92-53601

TR-I ROCKET ROLL CONTROL SYSTEM

JIRO KOUCHIYAMA, YASUHIRO FUNO (NASDA, Tokyo, Japan), SHIGEYUKI OGAWA, TERUO FUJIWARA, MEGUMU NISHIDA, and KAZUO HASEGAWA (Nissan Motor Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 1079-1084.

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A test rocket designated as TR-I was launched to acquire engineering design data for H-II, the Japanese next-generation satellite launcher, which has been under development by NASDA. A simple roll control system has been installed to the TR-I in order to maintain roll angle and roll rate within a limitation during the flight for assuring complete downlink of the telemetry system and for simulating flight conditions of the H-II. Major components of the roll control system, such as the Electronics Package (E-PACK), Inertial Sensor Package (ISP), Solid Motor Roll Control Unit (SMRC), and their hardware-in-the-loop (HWIL) simulation are discussed, referring to the actual flight data. Author

A92-53602

GUIDANCE AND CONTROL OF H-II ORBITING PLANE, HOPE

HITOSHI MINENO, YOSHISADA TAKIZAWA, TATSUSHI IZUMI, TOSHIKI MORITO, and NOBOYUSHI HAYASHI (NASDA, Guidance and Control Laboratory, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 1085-1090. refs

Copyright

The guidance and control technology of the first Japanese reusable orbiting space vehicle HOPE is described. HOPE is an unmanned fully automatic winged space vehicle which will be injected into an orbit by an H-II rocket from Tanegashima Space Center; it will land horizontally on a 3000-m runway. Special attention is given to the functions of the HOPE's guidance and control system; the system design; the details of the navigation, guidance, and control phases; the on-board equipment of the guidance and control system; and the summary of the equipment performance. I.S.

A92-53632

OVERVIEW OF JAPAN'S LAUNCH VEHICLES FOR SPACE APPLICATIONS

MASAFUMI MIYAZAWA (NASDA, Propulsion Group, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1297-1302. refs

Copyright

The National Space Development Agency of Japan has developed and operated satellite launch vehicles in the space application area over the past twenty years. The N-series rockets (N-I and N-II), Japan's first liquid-rocket boosters, and the current H-I rocket were developed based on U.S. technology transferred through intergovernmental agreements. Specifically, major components of the N-series rockets and the first stage of the H-I rocket are direct derivatives from the U.S. Delta rocket technology. To meet the requests of Japan's satellite users for orbiting large-capacity applications satellites in the 1990s, NASDA is now designing and developing the H-II launch vehicle based on domestic technology. It is capable of placing a 2000 kg payload into geosynchronous earth orbit. This paper presents the historical background of Japan's launch vehicle development program in the space applications area. Along with configuration change and capability growth, the significance of U.S. technology in Japan's space development programs is also reviewed. Author

A92-53634

H-II ROCKET DEVELOPMENT PROGRAM

M. MIYAZAWA, Y. FUKUSHIMA, H. KATSUTA, T. NAKAMURA, and T. FUJITA (NASDA, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan,

15 LAUNCH VEHICLES AND SPACE VEHICLES

May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1309-1318. refs

Copyright

NASDA's H-II has been developed to serve as a highly cost-effective heavy satellite payload launcher. The present development status evaluation for this launcher gives attention to test results for its solid rocket boosters and payload fairing, as well as to the H-II guidance and control system and launch facilities/operations. In order to achieve a launch rate greater than the current two/year, the H-II vehicle will be separately assembled and then carried to the pad service tower on a mobile launcher.

O.C.

A92-53636

A TRADE-OFF STUDY OF CARGO CARRIERS FOR THE SPACE STATION

YOSHIO YAMADA, NORIYOSHI SAITO, TAKESHI MATSUDA, KAZUHISA KITAKURA, and YOSHIMASA TAJIMA (NASDA, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1325-1328. refs

Copyright

Several launch vehicle configurations based on different engine technologies are presently subjected to a tradeoff study in order to ascertain the optimal candidate for 20-ton payload mass cargo transport duties associated with the building of NASA's Space Station Freedom. The launch-vehicle alternatives were scaled according to optimum stagings and trajectory simulations; launch costs were estimated for each case on the basis of sizing-study results. Attention is given to fuel types and degrees of vehicle reusability.

O.C.

A92-53639

AERODYNAMIC STUDY OF H-II ORBITING PLANE, HOPE

TOSHIO AKIMOTO, TETSUICHI ITO, NORIO SUZUKI (NASDA, Tsukuba Space Center, Japan), KOKUICHI HOZUMI, SEIZOU SAKAKIBARA, and IWAO KAWAMOTO (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1349-1354.

Copyright

NASDA's HOPE will be launched by an H-II vehicle and inserted into 250-km altitude orbit; after four days in orbit either conducting experiments or Space Station rendezvous and docking missions, HOPE will deorbit and automatically land on a runway. An account is given of the results of a study of the aerodynamics of the HOPE vehicle which was conducted in cooperation with Japan's NAL. Wind tunnel test results show that the double-delta planform must have long wingtip fins in order to possess positive static directional stability at low speed, as well as the requisite viscous-interaction parameter effects at hypersonic speeds and better aerodynamic heating distribution.

O.C.

A92-53640

PRE-FLIGHT PHYSICAL SIMULATION TEST OF HIMES REENTRY TEST VEHICLE

JUN'ICHIRO KAWAGUCHI, YOSHIFUMI INATANI (Institute of Space and Astronautical Science, Sagami-hara, Japan), KOICHI YONEMOTO (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), and SHIGERU HOSOKAWA (Mitsubishi Precision Co., Ltd., Kamakura, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1355-1363. refs

Copyright

ISAS is now developing a small reentry test vehicle, which is 2m long with a 1.5m wing span and weighs about 170 kg, for the purpose of exploring high angle-of-attack aerodynamic attitude control issue in supersonic and hypersonic speed. The flight test, employing 'Rockoon' launch system, is planned as a preliminary design verification for a fully reusable winged rocket named HIMES (Highly Maneuverable Experimental Space) vehicle. This paper

describes the results of preflight ground test using a motion table system. This ground system test is called 'physical simulation' aimed at: (1) functional verification of side-jet system, aerodynamic surface actuators, battery and onboard avionics; and (2) guidance and control law evaluation, in total hardware-in-the-loop system. The pressure of side-jet nozzles was measured to provide exact thrust characteristics of reaction control. The dynamics of vehicle motion was calculated in real-time by the ground simulation computer.

Author

A92-53713

DYNAMICAL ASPECTS OF LUNAR PENETRATOR

MASAHIRO KOHNO, SHIGEKI TSUKAMOTO, JUN'ICHIRO KAWAGUCHI, HITOSHI MIZUTANI, and MOTOKI HINADA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1865-1870.

Copyright

The study of the internal structure of planets can be aided by the use of 'penetrators', or ballistic ground-impact/penetration vehicles that carry impact-proof instrumentation and are shielded from the given body's adverse surface conditions by the depth from which they operate. Attention is presently given to the preliminary design of a penetrator that will be released from spin-stabilized spacecraft in lunar polar orbit and can contain a telemetry unit. The results of experimental penetrator deployment trials are presented.

O.C.

A92-53716

CONCEPTUAL DESIGN OF LUNAR LANDER

TSUTOMU IWATA, YUTAKA KANEKO (NASDA, Tsukuba Space Center, Japan), TOSHIYUKI TANAKA, TATSUHIRO NOZUE, and TAKASHI NAKAJIMA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1885-1890.

Copyright

An account is given of the H-II booster-launched, unmaned and expendable lunar lander configuration envisioned for initial phases of lunar exploration; the lander will be able to transport both a lunar surface-rover vehicle and a sample-return vehicle to the polar region of the moon. The lunar lander and payload will have the greatest possible subsystem commonality in order to minimize launch mass. The lunar lander will accordingly use the payload's communications, data-management, and electrical power systems.

O.C.

A92-55098

HOPE RE-ENTRY EXPERIMENTAL VEHICLE

SHO MIYAKE, SHOICHIRO ASADA (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan), and TOSHIO AKIMOTO (NASDA, Tokyo, Japan) Mitsubishi Heavy Industries Technical Review (ISSN 0026-6817), vol. 29, no. 2, June 1992, p. 137-144.

Copyright

An Orbital Reentry Experiment Vehicle (OREX) that is scheduled to be flown onboard the H-II Orbiting Plane (HOPE) in February, 1993 by NASDA is described focusing on the plan of the experiment and vehicle configurations. The OREX is expected to provide valuable data on hypersonic aerodynamics, aerothermodynamics, thermal protection systems, etc. during atmospheric reentry. Particular attention is given to the relationship between the vehicle's shape and aerodynamic characteristics and a concept of heat-resisting structure and thermal protection systems.

O.G.

A92-55166#

DEVELOPMENT OF THE ATTITUDE AND RATE CONTROL SYSTEM OF THE TR-1A ROCKET USING FIBER OPTIC GYRO

HIDEHIKO MORI, JIRO KOCHIYAMA, MAKOTO MIWADA, TOSHIAKI SATO (NASDA, Tokyo, Japan), TERUO FUJIWARA, SEIJI MATSUDA, KAZUO HASEGAWA (Nissan Motor Co., Ltd.,

15 LAUNCH VEHICLES AND SPACE VEHICLES

Tokyo, Japan), and HIROSHI OKAYAMA (Japan Aviation Electronics Industry, Ltd., Akishima) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 1. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 127-133. (AIAA PAPER 92-4319) Copyright

The control system for the TR-IA sounding rocket is described which is used for attitude and rate control. The attitude-control system comprises an inertial sensor package (ISP) with three fiberoptic gyros and three accelerometers. The ISP detects angular velocity and acceleration by means of a three-axis rate and acceleration sensors incorporating an integrated floating-rate gyro, a ring-laser gyro, and a fiberoptic gyro with no moving parts nor G-sensitive drift. A pendulum servo accelerometer is capable of measuring acceleration from ± 20 G to 100 microG. The attitude angle of the rocket is calculated with a transport matrix from rigid-body to inertial coordinates. The attitude and rate control system was employed on a TR-IA flight, and the results demonstrate its capability for effective minimization of impact dispersion and apogee dispersion as well as good despin of the experimental payloads. C.C.S.

A92-55627

FUEL STATION-BASED TRANSPORTATION NETWORK AS A FUTURE SPACE INFRASTRUCTURE

TORU TANABE and SHINICHI NAKASUKA (Tokyo, University, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. refs (IAF PAPER 92-0168) Copyright

Space fuel station is a promising new element of the future space transportation system. With this facility, some novel transportation schemes will be possible which assume reusable, space based orbital transfer vehicles (OTVs) and the separate launch of payloads, OTVs and fuel. Enhancement of vehicle capability, improvement of transportation flexibility and reduction of launch load can be expected in these new schemes, which will reduce the transportation cost for large future transportation demands. This paper analyses a novel transportation system based on such fuel stations, named OTV Network, as a integrated transportation infrastructure for earth orbital missions, lunar missions and interplanetary missions. Cost analysis indicates that OTV Network is more cost-effective than the conventional system under large demand environment especially where many interplanetary or retrieval missions exist. Factors which have large effects on the total system cost are identified, and the features of the system and some technical issues for realizing it are also discussed. Author

A92-56069

LATERAL CONTROL OF SPACEPLANE AT HYPERSONIC FLIGHT

SHINJI SUZUKI and MASAKI TORIUMI IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 302-305. In Japanese. refs

A spaceplane at hypersonic flight with a high angle of attack does not have the sufficient control power of aerodynamic control surfaces. Therefore, spaceplanes generally utilize the reaction jet for lateral attitude control. This paper applies the optimum pulse control theory, which optimizes the amount of roll and yaw jet impulse, with the assistance of an elevon deflection for a bank angle control. Numerous simulations are studied to investigate an effectiveness of the present control system. Author

A92-57075

JAPAN'S NEW SOLID-ROCKET BOOSTER AND ITS DERIVATIVE LAUNCHER

MASAFUMI MIYAZAWA, YUKIO FUKUSHIMA, HIROSHI MIYABA (NASDA, Tokyo, Japan), TATEO HOSOMURA, and TATSURO ASAI (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. refs (IAF PAPER 92-0629) Copyright

The current status of the design and development of the Japanese H-II SRB and its derivative launch vehicle is presented. Four full-scale static firing tests of the solid rocket motor have been conducted and the flight hardware is presently in production. Attention is given to the solid rocket booster configuration, design features, thrust vector control, and component development.

R.E.P.

N92-22090# National Space Development Agency, Tokyo (Japan). Launch Vehicle Group.

OUTLINE OF THE MICROGRAVITY EXPERIMENT ROCKET (TR-1A)

JIRO KOCHIYAMA *In its* Preprints of NASDA's 5th Technical Symposium p 1-30 1 Jun. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

In 1989, the National Space Development Agency of Japan (NASDA) decided to conduct the space processing experiment project, using the new microgravity experiment rocket (TR-1A), for the effective utilization of the Japanese Experiment Module, one part of the international space station. The project goal is to obtain the basic know-how of microgravity experiments and experimental devices through the flight opportunity of TR-1A (Test Rocket-1A) rocket. This TR-1A rocket can project a 1500 kg gross payload to about 270 km altitude and remain in a free fall condition about six minutes or more. Obtained microgravity condition is less than $10(\text{exp } -9)\text{G}$. The first flight will be held in 1991, and now the development of the rocket and experimental devices are ongoing. This report describes an outline of the microgravity experiment rocket (TR-1A) and its standing point and prospect in the test rocket family. Author (NASDA)

N92-24634# Tokyo Univ., Sagami-hara (Japan). Inst. of Space and Astronautical Science.

ULTRA-SMALL SATELLITE AND LAUNCH VEHICLE

H. MATSUO (Tokyo Univ. (Japan).), T. HAYASHI (Chiba Inst. of Tech., Narashino, Japan), and H. SAITO *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research p 257-260 Nov. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

An idea of a very small satellite launcher and a very small satellite is presented. The launcher is a three stage solid rocket based on a Japanese single stage sounding rocket S-520. Its payload capability is estimated to be 17 kg into 200,000 km elliptical orbit. The spin stabilized satellite with Sun pointing capability, though small, has almost all functions necessary to usual satellites. In its design, universality is stressed to meet various kinds of mission interface requirements and it can afford 6 kg to mission instruments. ESA

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SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

A92-53630

TR-IA PAYLOAD RECOVERY SYSTEM

JIRO KOCHIYAMA (NASDA, Tokyo, Japan), SHIGEKI KINAI, and SHINYA MORITA (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1283-1289. Copyright

The TR-IA microgravity-experimentation sounding rocket baseline configuration and recovery system are presented. Aerodynamic braking is incorporated through the requisite positioning of the reentry-body center of gravity. The recovery

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sequence is initiated by baroswitches, which eject the pilot chute. Even in the event of flotation bag malfunction, the structure containing the experiment is watertight. An account is given of the nature and the results of the performance tests conducted to establish the soundness of various materials and components.

O.C.

N92-25371# National Space Development Agency, Tokyo (Japan).

PREPRINTS OF NASDA'S 6TH TECHNICAL SYMPOSIUM [DAI 6 KAI UCHUU KAIHATSU JIGYODAN GIJITSUSEIKA HAPPYOKAI MAEZURISHUU]

5 Jun. 1991 101 p In JAPANESE Symposium held in Tokyo, Japan, 5 Jun. 1991 Submitted for publication
(JTN-92-80347) Avail: CASI HC A06/MF A02

The following topics were discussed: spacelab, space station, space shuttle, payload specialist, crew training, JEM (Japanese Experiment Module), spacecraft modules, spacecraft structures, spacecraft design, manned orbital laboratories, OREX (Orbital Re-entry Experiment), reentry vehicle, hypersonic reentry, test vehicle design, Japanese spacecraft, FMPT (First Material Processing Test), HOPE (H-2 Orbiting Plane); aerodynamic heating characteristics, reentry effects, thermal protection, and reentry shielding.

Author (NASDA)

N92-33787# National Space Development Agency, Tokyo (Japan). System Engineering Dept.

FUTURE TRANSPORTATION SYSTEMS [SHOURAI GATA YUSOU KEI NI TSUITE]

TAKAO ETOU In its Future Space Activities Workshop: Lunar Base Workshop 1991 12 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

A study was made of fly-back boosters as one future space transportation system. After presenting premises for review such as launch date, launch site, system configurations, numbers of reuse, and system structure, the following topics were discussed: speed increments, specific impulse, structural efficiency, sizing, performance balance optimization, and configurations. Comparison of various Japanese launch vehicles, relationship between lifted weight and payload weight, between propellant weight and tank length, performance balance optimization, and candidate configurations are presented with tables and charts. Separation speed of the booster is a problem peculiar to the fly-back booster. Reentry conditions and landing place are determined by the separation speed.

Author (NASDA)

N92-33788# Mitsubishi Heavy Industries Ltd., Tokyo (Japan).
REVIEW ON ORBIT TRANSFER VEHICLES TO BE LAUNCHED BY H-2 LAUNCH VEHICLES [H-2 ROKETTO TOUSAI GATA KIDOU KAN YUSOU KI NO KENTOU]

TAKAHIRO ITOU In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

Results of the review on the Orbit Transfer Vehicle (OTV) to be launched by H-2 launch vehicles are presented. The prerequisites, including transportation profiles, necessary speed increments from the earth to the moon, comparison of transportation capabilities in unmanned lunar exploration phase of the OTV's, conceptual study and examples of the mission such as lunar landing, lunar sample return, and earth geostationary orbit injection, are outlined. Conceptual drawings and major characteristics of the OTV propulsion systems, power and weight balance (for lunar transfer orbit injection), and 4.1 tons and 1.6 tons class lunar landing vehicles are presented.

Author (NASDA)

N92-33789# Hitachi Ltd., Tokyo (Japan).

CONCEPTUAL STUDY ON ORBIT TRANSFER VEHICLE LAUNCHED BY H-2 LAUNCH VEHICLES [H-2 ROKETTO YOU KIDOU KAN YUSOU KI NO GAINEN SEKKEI]

KOUHEI KATOU, MASAYA YAMAMOTO, TAKESHI KAWAZOE, KAZUHISA KANEKO, and TOSHIYUKI TANAKA In NASDA, Future

Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

A conceptual study of the Orbit Transfer Vehicle (OTV) is conducted on the overall systems and propulsion systems. The premises for the study are: (1) OTV is mounted on the 2nd-stage of an H-2 launch vehicle and injected into Low Earth Orbit (LEO); and (2) OTV can be used for multiple missions such as lunar and planet exploration and geostationary missions. The results of orbit calculation for several missions are shown, and the system features, mass and power balance, and system structure of the OTV are presented. The results of reviews on the transportation capability, types of engine (specific impulse, thrust, and engine cycles), and performance and characteristics of main propulsion system are outlined. Main technical problems to be solved for realizing the propulsion system are: (1) high performance turbopump and heat exchanger development for LOX/LH2 expander cycle engine; and (2) engine low expansion section and deployment mechanism.

Author (NASDA)

N92-33792# Mitsubishi Heavy Industries Ltd., Tokyo (Japan).

REVIEW ON TRANSPORTATION SYSTEMS FOR MANNED LUNAR MISSIONS [YUJIN TSUKI MISSHON NI KANSURU YUSOU SHISUTEMU NO KENTOU]

TAKAHIRO ITOU In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 14 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

A transportation system from earth revolving orbits to the lunar surface, to be used in the manned lunar surface sites phase, in which three astronauts stay at the site during day time only, is reviewed. The review examines the system functional balance between composing elements and selection of the overall manned lunar transportation system and on subsystems such as manned transportation module, lunar landing vehicle, and lunar transportation vehicle. The following topics are covered: (1) representative example of earth-moon transportation profiles and required speed increments; (2) overall lunar transportation system structures; (3) functional balance between subsystems; (4) outline characteristics of manned transportation module; and (5) conceptual drawings and outline characteristics of lunar landing and take-off, and lunar transport vehicles.

Author (NASDA)

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SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

A92-15297* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

SPACE NETWORK INTEROPERABILITY PANEL (SNIP) STUDY

THOMAS RYAN (NASA, Goddard Space Flight Center, Greenbelt, MD), KLAUS LENHART (ESA, European Space Operations Centre, Darmstadt, Federal Republic of Germany), and HIDEO HARA (NASDA, Tracking and Data Acquisition Dept., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 12 p. refs

(IAF PAPER 91-458) Copyright

The Space Network Interoperability Panel (SNIP) study is a tripartite study that involves the National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and the National Space Development Agency (NASDA) of Japan. SNIP involves an ongoing interoperability study of the Data Relay Satellite (DRS) Systems of the three organizations. The study is broken down into two parts: Phase one deals with S-band (2 GHz) interoperability and Phase two deals with Ka-band (20/30 GHz) interoperability (in addition to S-band). In 1987 the SNIP formed a Working Group to define and study operations concepts and

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technical subjects to assure compatibility of the international data relay systems. Since that time a number of Panel and Working Group meetings have been held to continue the study. Interoperability is of interest to the three agencies because it offers a number of potential operation and economic benefits. This paper presents the history and status of the SNIP study. Author

A92-16939

THE APPLICATION OF GPS NAVIGATION SYSTEM TO THE H-II ORBITING PLANE

ISAO KAWANO, YASUFUMI WAKABAYASHI, TATSUSHI IZUMI (NASDA, Tsukuba, Japan), MASATOSHI HARIGAE, MASAYUKI IKEUCHI, and HIROAKI MAEDA (Toshiba Corp., Kawasaki, Japan) IN: ION GPS-90; Proceedings of the 3rd International Technical Meeting of the Satellite Division of the Institute of Navigation, Colorado Springs, CO, Sept. 19-21, 1990. Washington, DC, Institute of Navigation, 1990, p. 305-314. refs

Analytical results of GPS receiver design and orbit determination are presented including expected pseudorange and delta pseudorange variations, tolerance to high dynamic motion, antenna location, and navigation performance as applied to the Japanese H-II orbiting plane. The receiver design will be initially verified by installing the GPS receiver on the orbital reentry experimental vehicle, OREX. Details of the OREX experiment to be launched by the first H-II rocket are discussed. R.E.P.

A92-18498

RECENT DEVELOPMENTS IN INTERSATELLITE LASER COMMUNICATION TECHNOLOGIES AT NASDA

HIROSHI ARIKAWA and SHIGEHARU NAKAMORI (NASDA, Tsukuba Space Center, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs (IAF PAPER 91-479) Copyright

National Space Development Agency of Japan (NASDA) has been studying and developing an intersatellite laser communication (ILC) system and plans to perform ILC experiments in space between the Japanese Experimental Module and the Data Relay and Tracking Satellite (DRTS). NASDA has fabricated and tested trial models of key constituents for the acquisition, tracking and pointing subsystem, i.e., one of the most critical technologies in the ILC system. This paper outlines the ILC study and the status of the current developments in the ILC at NASDA. Author

A92-18517

OVERVIEW OF SATELLITE ON-BOARD MULTIBEAM COMMUNICATIONS SYSTEM FOR ETS-VI

SHUICHI SAMEJIMA, MASAYOSHI TANAKA, and ISAO OHTOMO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs (IAF PAPER 91-507) Copyright

A multibeam system is one of the most promising next-generation satellite communication systems. NTT is taking part in the Japanese national ETS-VI program in developing on-board equipment for fixed and mobile multibeam satellite communication systems and is preparing for the evaluation and verification of newly developed technologies. Ground verification tests of this equipment have successfully been completed and the assembly of the Proto-Flight-Model has started with the launch scheduled for 1993. Author

A92-20385

MU RADAR MEASUREMENTS OF ORBITAL DEBRIS

TORU SATO, IWANE KIMURA (Kyoto University, Japan), HIDETOSHI KAYAMA, and AKIRA FURUSAWA Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 28, Nov.-Dec. 1991, p. 677-682. Previously cited in issue 13, p. 1970, Accession no. A90-32041. refs Copyright

A92-20391

POSITIONING SATELLITE SYSTEM USING INTERSATELLITE COMMUNICATION

KENICHI INAMIYA (Mitsubishi Electric Corp., Kamakura, Japan) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 28, Nov.-Dec. 1991, p. 720-727. refs Copyright

A new concept for a positioning system using satellites is presented in this paper. A proposed constellation, consisting of four satellites injected into geosynchronous altitude (GEA) with a high inclination, is connected with intersatellite communication. Range differences data between satellites measured by an observer are input to the positioning algorithm. First the measurement principle of the system is explained, then the feasibility studies are performed. The system uses a relative time for the measurements, and therefore does not need the degree of accuracy required in the GPS. According to the studies performed here, any observer in an area lower than around 60 deg of latitude can, using a 10-satellite constellation, find the given position with an accuracy of 176.5-499.8 m (in case of a system error of 30.8 m). The positioning errors of some cases are evaluated. Author

A92-22638

A STUDY ON HOPE GUIDANCE, NAVIGATION, AND CONTROL TECHNOLOGY

YOSHISADA TAKIZAWA, HITOSHI MINENO, TATSUSHI IZUMI, MAMORU FUKUI, TOSHIKI MORITO, and NOBUYOSHI HAYASHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 615-622. In Japanese. refs

The guidance, navigation, and control systems of HOPE (H-II Orbiting Plane) are presented. An interpretive computer simulation program and an in-circuit emulator have been designed. Y.P.Q.

A92-22639

HOPE RENDEZVOUS AND DOCKING SYSTEM

YASUFUMI WAKABAYASHI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 454, 1991, p. 622-628. In Japanese. refs

The concept of the HOPE (H-II Orbiting Plane) rendezvous and docking (RVD) system is addressed. Basic RVD concepts for low earth orbit activities are described. The guidance and control system is also presented. Y.P.Q.

A92-26788

HYBRID SYSTEM OF COMMUNICATION AND RADIO DETERMINATION USING TWO GEOSTATIONARY SATELLITES

EIHISA MORIKAWA, SEIJI MARUYAMA, FUMIO KAWAMATA, SHINGO OHMORI, YASUSHI MATSUMOTO, and KIMIO KONDO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 119-126. In Japanese. refs

Mobile satellite services are classified into two categories, that is, communications and radio determination. A service which provides both services in a system is studied and developed. A hybrid system is being developed which can provide both communications and positioning services in a system. Using this system both functions of communications and radio determination can be obtained with two geostationary satellites. Author

A92-26790

RADIO DETERMINATION SATELLITE SYSTEM

SHINGO OHMORI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 145-166. In Japanese. refs

This paper outlines the Radio Determination Satellite System which is in operation and under development. The problems of frequency allocation and service definition are also described. Author

A92-26996* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

SPACE NETWORK INTEROPERABILITY PANEL (SNIP) STUDY THOMAS RYAN (NASA, Goddard Space Flight Center, Greenbelt, MD), KLAUS LENHART (ESA, European Space Operations Centre, Darmstadt, Federal Republic of Germany), and HIDEO HARA

(NASDA, Tracking and Data Acquisition Dept., Tokyo, Japan)
AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV,
Jan. 6-9, 1992. 12 p.

(AIAA PAPER 92-0596) Copyright

The Space Network Interoperability Panel (SNIP) is described in terms of the panel's composition, purpose, history, and ongoing activities. SNIP is a consortium comprising NASA, ESA, and NASDA that is dedicated to the study of interoperability of the data-relay satellite (DRS) systems of the three groups. S-band and Ka-band interoperability are addressed by the SNIP study program by means of defining operations concepts, technical subjects, and other matters relevant to international DRS system compatibility. The potential users of the interoperability scheme are listed, cross-support techniques are described, and the load situations of the three agencies are characterized. A common 'interoperability frequency framework' is proposed, and both left-and right-hand circular polarization are incorporated to enhance flexibility and minimize interference. An operations concept is outlined based on these and other recommendations as developed by the international SNIP study.

C.C.S.

A92-29762#

PERFORMANCE OF COMMUNICATIONS AND RADIO DETERMINATION SYSTEM USING TWO GEOSTATIONARY SATELLITES

E. MORIKAWA, Y. ARAKAKI, N. OBARA, K. KIMURA, H. WAKANA (Communications Research Laboratory, Kashima, Japan), and M. WAKAO (Research and Development Center for Radio Systems, Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 84-91. refs

(AIAA PAPER 92-1814) Copyright

The Communications Research Laboratory (CRL) of the Ministry of Posts and Telecommunications has developed a new hybrid satellite system which can provide both communication and positioning services in one system using two geostationary satellites. The distinctive feature is that positioning of mobiles and communication such as voice and data transmission can be carried out over the same channel at the same time. Two types of hybrid terminals using different methods have been developed for experiments with the hybrid satellite system. The first is called the Single Channel Per Carrier (SCPC) method, and the second is called the Spread Spectrum (SS) method. This paper describes the configuration and features of the SCPC and SS terminals, an outline of the experimental system and the experimental results. Experiments using the SCPC and SS terminals were carried out in the Pacific Ocean and several locations in Japan, respectively.

Author

A92-29779#

ETS-VI LASER COMMUNICATIONS EXPERIMENT SYSTEM

K. ARAKI, Y. ARIMOTO, M. SHIKATANI, M. TOYODA, and T. ARUGA (Communications Research Laboratory, Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 248-254. refs

(AIAA PAPER 92-1833) Copyright

An experimental free-space laser communication system has been developed on the basis of the optics payload carried by the Japanese Engineering Test Satellite VI (ETS-VI), which is scheduled for launch into GEO in August 1993. Attention is given to this Laser Communications Experiment (LCE) system's laser link, optics payload, ground optics system, and planned research activities. These experiments with the ETS-VI optics will laser-link to a ground control site near Tokyo; the LCE uses an 0.83-micron diode laser for the downlink, while the uplink is handled by an 0.51-micron argon-ion laser.

O.C.

A92-29780#

PRESENT AND FUTURE ACTIVITIES IN OPTICAL SPACE COMMUNICATIONS AT ATR

YOSHINORI ARIMOTO, MITSUO NOHARA, KEIZO INAGAKI, MASAYUKI FUJISE, and YOJI FURUHAMA (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 255-262. refs

(AIAA PAPER 92-1834) Copyright

ATR has been conducting research on an optical inter-satellite link (ISL), focusing on a high-power transmitter and precise optical beam control technologies, both of which play a very important role in the optical ISL systems. This paper describes current optical ISL research at ATR: development of an intensity modulation/direct detection modem, LD amplifier experiments, development of a free-space simulator for laser transmission and evaluation of pointing/tracking parameters for various orbit configurations. The evaluations show that a system in a LEO satellite tracking a target in GEO will be simplified when a particular gimbal axis configuration is selected.

Author

A92-29820#

DATA RELAY SYSTEM CONCEPT FOR JAPAN

KENJI MORIBE, JUN GOMI, HIDEO HARA, KANACHIRO KASHIWAGI (NASDA, Tokyo, Japan), HIDEO KIKUCHI, YOICHI KOISHI, and SEIJI KUROIKI (Toshiba Corp., Kawasaki, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 604-610.

(AIAA PAPER 92-1884) Copyright

NASDA has planned the development of a space network ground system using data relay satellites to collect data from spacecraft and support their activities. Here, the space network ground system concept is described. The development plan for the space network is summarized, including the planned ETS-VI and COMETS Space Network and tests. The ground system for the ETS-VI test is described in some detail, and a conceptual study for the future network is briefly discussed.

C.D.

A92-33625

SINGLE SHAPED REFLECTOR ANTENNAS FOR BROADCASTING SATELLITES

KAZUYOSHI SHOGEN, HAYATO NISHIDA, and NOBORU TOYAMA (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 40, Feb. 1992, p. 178-187. refs

Copyright

For future direct broadcasting satellites (DBSs) in Japan, precisely contoured beam antennas will be required for onboard antennas. Single shaped-reflector antennas are suitable for that purpose, since they do not need complex feed networks. However, in a previous study, discontinuities in the reflector surface were observed. The problem of the discontinuity was circumvented in this work and the shaped reflectors were successfully designed to produce contoured beams for covering the Japanese islands for the downlink and feederlink antennas. The downlink antenna was fabricated, and the radiation pattern was verified by measurement. The radiation pattern meets the radio regulations imposed on the onboard antenna, such as sidelobe and cross-polarization characteristics.

I.E.

A92-35607

FUNDAMENTAL DESIGN OF THE COMMUNICATION CONTROL SYSTEM OF THE JAPANESE EXPERIMENT MODULE (JEM)

K. IZUKA, K. NAKAZAWA, and TETSURO YOKOYAMA (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 9, 10. In Japanese.

The design of the communication control system of the Japanese Experiment Module (JEM) is presented. The JEM control

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processor and JEM work station are discussed. The high speed data transmission system, the video inspection system, and the acoustic system are described. Y.P.Q.

A92-35621

THE FACILITIES PREPARATION PLAN FOR TELESCEIENCE TECHNOLOGICAL DEVELOPMENT

S. HIGUCHI, MORIO SHIMUZU, YOSHINORI FUJIMORI, and T. KUSUNOSE (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 37, 38. In Japanese. refs

The concept of the utilization and operation of the telescience technological development is discussed. The facility structures are illustrated. Telescience testbed results for the Japanese Experiment Module (JEM) are reported. Y.P.Q.

A92-35640

CURRENT STATUS AND FUTURE TASKS OF OPTICAL OBSERVATION TECHNOLOGY FOR SPACE DEBRIS

K. ARAKI, YOSHIKI SUZUKI (Ministry of Posts and Telecommunications, Tokyo, Japan), and Y. ARIMOTO (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 85, 86. In Japanese. refs

Optical observation technology for space debris in a system for ensuring the safety of a manned space vehicle is presented. A space debris distribution model is analyzed. The Ground-based Electro-Optical Deep Space Surveillance (GEODSS) system and the Central Research Laboratory system are compared. Y.P.Q.

A92-38141* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

SPACE NETWORK INTEROPERABILITY PANEL (SNIP) STUDY
DALE FAHNESTOCK (NASA, Goddard Space Flight Center, Greenbelt, MD), SHIGEO YAMADA, HIDEO HARA (NASDA, Tracking and Data Acquisition Dept., Tokyo, Japan), KLAUS LENHART (ESA, European Space Operations Centre, Darmstadt, Federal Republic of Germany), and THOMAS RYAN (NASA, Goddard Space Flight Center, Greenbelt, MD) AIAA, International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992. 12 p.
(AIAA PAPER 92-1886) Copyright

The history and status of the SNIP study conducted by NASA, ESA, and NASDA are reviewed. Particular attention is given to data relay systems development plans; agency load situations; cross support; the top managers agreement about implementation of S-band interoperability and accelerating the K-alpha band high data rate exploration; testing of actual systems; NASA interim architecture for an S-band era system to make NASA spacecraft and TDRSS/TDRS-II compatible with ESA and NASDA systems; tropical rainfall measuring mission support; S-band cross support; and K-alpha band status. O.G.

A92-38615*

NASDA'S SPACE OPERATIONS AND DATA SYSTEM II

H. HARA, S. YAMADA, S. IGARASHI (NASDA, Tokyo, Japan), K. HORIGUCHI, Y. KUNIASU, S. KUROKI (Toshiba Corp., Komukai Works, Kawasaki, Japan), S. NISHIHATA, A. ONIYAMA (NEC Corp., Yokohama, Japan), and M. YAMBE (Fujitsu, Ltd., Tokyo, Japan) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. refs
(AIAA PAPER 92-1511) Copyright

NASDA has begun the definition of its satellite tracking-and-control Space Operations and Data System II, which will encompass the launching of the COMETS telecommunications and broadcasting technology engineering satellite in 1997. The satellites that are to transfer data with COMETS via an intersatellite link encompass the next-generation earth-observing satellite ADEOS, the Tropical Rainfall Measurement Satellite, the Engineering Test Satellite II, and the Japanese Experiment Module

of Space Station Freedom. Detailed schematics for these systems' interrelations are provided. O.C.

A92-39554*

Jet Propulsion Lab., California Inst. of Tech., Pasadena.

NAVIGATION FOR MUSES-A (HITEN) AEROBRAKING IN THE EARTH'S ATMOSPHERE - PRELIMINARY REPORT

J. KAWAGUCHI, T. ICHIKAWA, T. NISHIMURA, K. UESUGI (Institute of Space and Astronautical Science, Sagami-hara, Japan), L. EFRON, J. ELLIS, P. R. MENON, and B. TUCKER (JPL, Pasadena, CA) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 17-27. refs

Aerobraking phase covariance study results and preliminary joint JPL/ISAS orbit determination findings are presented. Possible explanations for differences in the JPL and ISAS perigee altitude results are discussed. Agreement between predicted and reconstructed values for the altitude and time of perigee passage attests to the accuracy of the JPL orbit solutions. C.A.B.

A92-40192

POSITIONING DETERMINATION AND COMMUNICATIONS USING TWO GEOSTATIONARY SATELLITES

EIHA MORIKAWA, RYU MIURA, KAZUHIRO KIMURA, SEIICHIRO KAWASE, SHINGO OHMORI, YASUSHI MATSUMOTO (NASDA, Tokyo, Japan), and MASAYOSHI WAKAO (Research and Development Center for Radio Systems, Tokyo, Japan) Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 249-258. refs

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A hybrid satellite communication system has been developed which can provide both communications and positioning services in one system using two geostationary satellites. The experimental system consists of the ETS-V (150 deg E) and INMARSAT (180 deg E), a base earth station (Kashima Space Research Center, Japan), and mobile earth stations. The frequencies between the satellites and mobile stations are 1.6/1.5 GHz. The distinctive feature of this system is that position determination of the mobile earth stations and communication, such as voice and data transmission, can be carried out over the same channel at the same time. Another feature is that the frequency bandwidth of the system is very narrow compared to those of GPS and GEOSTAR. The two types of terminals developed for the experiments with this hybrid system use the single channel per carrier method and the spread spectrum method. An outline of the experimental system is presented, and the estimated positioning accuracy is described. S.A.V.

A92-40195

NEW DEVELOPMENT OF SATELLITE LASER RANGING SYSTEM FOR HIGHLY PRECISE SPACE AND TIME MEASUREMENTS

HIROO KUNIMORI, KUNIASU IMAMURA, FUJINOBU TAKAHASHI, TOSHIKAZU ITABE, TADASHI ARUGA, and ATSUSHI YAMAMOTO (Maritime Safety Agency, Kure, Japan) Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 303-317. refs

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The Communications Research Laboratory has developed a satellite laser ranging system as one facility in the Space Optical Communication Research Center in Tokyo, Japan. The system is equipped with a 1.5 m receiving telescope, 100 ps/100 mJ/10 Hz mode locked YAG laser and high precision receiver electronics. Terrestrial ranging with about 1000 shots normal point shows good precision of less than 1 cm. The system will be used for various space and time measurements such as earth rotation measurement, satellite orbit determination and optical time transfer. Author

A92-40197

PRECISE POSITION DETERMINATION OF NEW KASHIMA VLBI STATION

YASUHIRO KOYAMA, JUN AMAGAI, and HITOSHI KIUCHI

Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 335-340. refs
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As the main station of the Western Pacific VLBI (Very Long Baseline Interferometry) Network, a large aperture antenna (34 m in diameter) has been constructed at Kashima Space Research Center (KSRC). Precise determination of the antenna position, which is defined as the intersection of azimuth and elevation rotation axes and is often used as a VLBI reference point, has been attempted by means of the geodetic VLBI technique. Each component of the 34 m antenna VLBI reference point in a geocentric Cartesian coordinate system has been estimated from four independent sets of experimental data by referring to the position of nearly 26 m antenna at KSRC. Two problems arise when a geodetic VLBI technique is applied to a short baseline. One is due to a phase calibration signal injected into the received signals, and the other is due to a time code header in a sequence of digitized data. Both largely affect the correlation function for detection of observable time delay. By solving these problems, internal error in estimation was reduced to about 3 mm for each component. Author

A92-47627 BASIC RESEARCH ON OPTICAL INTER-SATELLITE COMMUNICATION LINK

RISAO HAYASHI, TOSHIO IGUCHI, and KENICHI ARAKI
Communications Research Laboratory, Review (ISSN 0914-9279), vol. 38, no. 1, March 1992, p. 43-72. In Japanese. refs
Copyright

The distinctive and basic problems encountered in designing optical space communication systems are discussed. These include the effects of aberration, Doppler shifts, and background noise sources and the influence of background noise on optical communication links and on transmitting and receiving apparatus for optical communication systems, acquisition, and tracking. Present developments in optical intersatellite communication technology are briefly reviewed. C.D.

A92-53597 OPTICAL TRACKING OF GEOSTATIONARY SATELLITES USING 1.5M TELESCOPE SYSTEM WITH LOW-NOISE CCD CAMERA

YOSHINORI ARIMOTO, NORIHISA HIROMOTO (Communications Research Laboratory, Koganei, Japan), TETSUO AOKI (Tokyo, University, Japan), TOSHIKAZU ITABE, and TADASHI ARUGA (Communications Research Laboratory, Koganei, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1051-1056. refs
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Preliminary results of highly sensitive optical tracking of geostationary satellites are presented. The optical tracking system used in this experiment consists of a 1.5 meter diameter telescope, a liquid nitrogen cooled visible CCD camera, and an image data processing computer. In order to verify the system capability, sensitivity and tracking accuracy are measured by observing faint galaxies, stars, and satellites. The limiting magnitude of the telescope system was estimated to be about 19 m at a 10-second integration time by observing Japanese domestic geostationary satellites. The seeing size caused by air turbulence, which limits tracking accuracy, was 3 to 5 arcsec. It turned out to be quite easy to track geostationary satellites using the CCD imaging system, whenever the sky was clear at night. Author

A92-53598 RELATIVE ORBIT DETERMINATION OF GEOSTATIONARY SATELLITES BY DIFFERENTIAL ANGLE TRACKING

SEIICHIROU KAWASE (Communications Research Laboratory, Kashima, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1057-1062. refs
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The concept of differential angle observation from a ground station for the determination of the relative motion of two satellites closely placed in the geostationary orbit is presented. A linearized Kalman filter estimates the relative position and velocity taking account of the relevant perturbation. A tracking simulation using pseudo-differential angle data indicates an accuracy of a few hundred meters for the relative satellite position. Author

A92-53599 PRECISE ORBIT DETERMINATION OF GPS SATELLITES AND ACCURACY ANALYSES

MASAAKI MURATA (National Aerospace Laboratory, Chofu, Japan), TOMIYOSHI YAMAMOTO, and YASUHIRO HAMADA (Daiko, Ltd., Ageba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1063-1071. refs
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A GPS orbit determination software system called MSOP (Multi-Satellite Orbit Processor) has been developed. This software uses pseudo-range and carrier phase data to determine accurate orbits for the GPS satellite constellation. The paper describes some of the methods and strategies specific to GPS orbit determination with special emphasis on the force modeling for solar radiation pressure and y-bias. The orbit accuracy is evaluated from analysis of pseudorange data collected by the Cooperative International GPS Network (CIGNET). This evaluation is based primarily on the direct comparison with the precise ephemerides generated at the Naval Surface Warfare Center (NSWC). Methods leading to orbit accuracy at better than 0.5 ppm level have been demonstrated. Author

A92-53603 SPACE PLANE NAVIGATION SIMULATION

KOICHI MATSUSHIMA, MASAAKI MURATA, HIROKIMI SHINGU (National Aerospace Laboratory, Chofu, Japan), TETSUO SHIMIZU (Fujitsu, Ltd., System Laboratory, Tokyo, Japan), TATSUO MIKAMI, and YOSHIKAZU HASHIDA (Fujitsu, Ltd., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1091-1096. refs
Copyright

A simulation program for a future Japanese space-plane (SP) considered for development is presented along with the results of the analysis of a candidate navigation configuration, focused on the terminal area energy management phase and the approach/landing phase of SP. The guidance laws and aerodynamic parameters which are applied to the program for the analysis are modeled using the laws and parameters of the U.S. Space Shuttle, assuming typical values for the accuracy of sensors. I.S.

A92-53604 STUDY ON AN APPLICATION OF GRAVITY GRADIOMETER FOR STRAPDOWN INERTIAL NAVIGATION

HIROKIMI SHINGU (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1097-1104. refs
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This paper presents a method of obtaining a gravitational field vector from the data of gravity gradients measured in a moving vehicle. Gravity gradients are defined and formulated as second order spatial gradients of the gravitational potential in the field where the vehicle operates. The algorithms necessary to configure a new type of strapdown inertial navigation system using gravity gradiometers are derived. The navigation errors of the vehicle using the model of this new navigation system are evaluated by simulation. It is concluded that a more advanced strapdown inertial navigation system will be possible in the future when it becomes possible to precisely measure gravity gradients. Author

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A92-53617

CONCEPT OF POSITIONING SYSTEM FOR FUTURE SPACE SYSTEMS

TSUTOMU IWATA, KAZUMI OKUDA, YUTAKA KANEKO (NASDA, Tsukuba, Japan), SUSUMU KUMAGAI, HIROMI MORIYA, MASAHIRO KAKINUMA, and TAKASHI NAKAJIMA (Hitachi, Ltd., Space Systems Div., Totsuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 1189-1194. refs

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A positioning system incorporating communications and data-relay functions is described for applications to the Space Station Freedom, orbital transfer vehicles, and other spacecraft. The requirements of a space-positioning system are set forth with specific references to operational constraints, and communication methods are reviewed including time-division and code-division multiple-access methods. Code-division multiple access is proposed as the most effective method for space positioning, whereas time-division is more suitable for low-cost ground use. A positioning-system constellation is discussed with attention given to simulated results for GDOP and coverage/visibility required for the effective use of a space positioning system. A total of 15 space segments is proposed for a system with good visibility, GDOP, and switching frequency, although smaller systems are possible. C.C.S.

A92-53694

ON-BOARD SATELLITE SWITCH CONTROLLER FOR MULTI-BEAM COMMUNICATION SATELLITE

TAKASHI ONO and MASATO MORI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1741-1745. refs

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The compact and highly reliable satellite-switch controller (SSC) that is to be used by Japan's multibeam communications platform, the Engineering Test Satellite VI, is expected to have a survival probability of as much as 0.99 for a 10-year mission life. The satellite's weight and power consumption are respectively merely one-fourth and one-tenth those typical of conventional satellites with comparable capabilities. Immunity from cosmic ray-induced soft errors is obtained through the use of a modular-redundancy/adaptive error correction scheme. O.C.

A92-53695

ONBOARD PROCESSING FOR MILLIMETER-WAVE PERSONAL SATELLITE COMMUNICATIONS SYSTEM

NORIO KOMIYAMA, MINORU ENDO, NOBUO ISHIZU, YUICHI OTSU (Space Communications Research Corp., Tokyo, Japan), HIDEKI KITAGIRI, HIROSHI AKATSUKA, SHINJI SENBA, and YOSHIO OHGUSHI (NEC Corp., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1747-1752. refs

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The present investigation of the implementation of a mm-wave personal satellite communications system by the first decade of the next century notes that it is necessary to develop a lightweight onboard processor capable of furnishing demand assignment for the 100 channels/beam that would be required to assign, for 20 beams, over 2000 channels; these would serve over 200,000 users. An onboard processor with baseband switching allows a choice to be made as to the best scheme for up and down links. Proof-of-concept digital demodulators, and a multichannel group frequency demultiplexer, have been constructed for the onboard processor. O.C.

A92-53696

A SUPERVISORY AND CONTROL SYSTEM FOR ETS-VI COMMUNICATIONS EQUIPMENT

TOMOYUKI IZUMISAWA and KATSUMI SHIGENOBU (NTT, Radio

Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1753-1758. refs

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The Communications-equipment Supervisory and Control (CSC) system developed for multibeam communications equipment monitoring and control in the ETS-VI satellite can handle more than 10 times the telemetry and command items of conventional systems for single-beam communications satellites, while transmitting high-speed switching data to an onboard, IF satellite switch; this dynamically exchanges communications signals among the beams. The CSC's satellite and ground systems have been certified to be able to both monitor and control ETS-VI's communications equipment. O.C.

A92-53697

STUDY ON S-BAND INTEROPERABILITY FOR DATA RELAY SATELLITE

NOBURO KAWAJIRI, TUKASA MITO, AKIRA AWASAWA, TOSHIO DOURA, YUUNICHI FUJIWARA, SATOSHI NAGANO (NASDA, Tsukuba Space Center, Japan), and ALAIN ZAREMBOWITCH (ESTEC, Noordwijk, Netherlands) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1759-1764. refs

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NASA, ESA and NASDA data relay satellite systems must be interoperable at S-band. In order to define the recommended parameters of data relay satellite systems, it is essential to conduct both a communication link analysis and frequency analysis. For the communication link analysis, a simple communication link model, which includes the earth station segment, the user spacecraft segment and the data relay satellite segment is developed. The salient electrical parameters such as filter bandwidth of each segment are identified. For frequency analysis, the worst case that all user spacecraft use the same center frequency and the same polarization is considered. The statistics of interference and necessary orbit separation between geostationary data relay satellites are calculated. Author

A92-53698

DEVELOPMENT OF S-BAND INTERSATELLITE COMMUNICATIONS EQUIPMENT FOR ETS-VI

MASATO TANAKA, HIROSHI KITAHARA (NASDA, Tokyo, Japan), SHIGERU KIMURA, TAKEO ITOH, and MASAHARU FUJITA (Communications Research Laboratory, Koganei, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1765-1772. refs

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Accounts are given of the configuration, performance, and experimental trial plans for the ETS-VI communications satellite's S-band Intersatellite Communications (SIC) equipment. The SIC furnishes an access link for the intersatellite data relay and tracking satellite system, on the basis of an S-band multibeam phased-array antenna with electrically steerable beams. The system's enabling technologies are onboard beam-forming and beam-pointing, and an active-array configuration based on microwave integrated circuits and microstrip antennas. O.C.

A92-53700

DEVELOPMENT OF SPACE OPTICAL COMMUNICATION EQUIPMENT FOR ETS-VI

YOSHINORI ARIMOTO, MOTOKAZU SHIKATANI, SHIN YOSHIKADO, YOSHIKI SUZUKI, and TADASHI ARUGA (Communications Research Laboratory, Koganei, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1779-1784. refs

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A development status evaluation is presented for the onboard Laser Communications Equipment (LCE) of Japan's geostationary

Engineering Test Satellite, which will be employed for fundamental experiments pertinent to future intersatellite optical communications systems. These experiments will treat high-precision spacecraft tracking, dual-link optical communication, high-accuracy attitude measurements, point-ahead angle verification, and laser beam space propagation. A fixed ground station will also figure in these communications links between GEO, LEO, and earth. O.C.

A92-53703

EXPERIMENTAL MILLIMETER-WAVE SATELLITE COMMUNICATIONS SYSTEM

MASAAKI SHIMADA, YOSHIKI SUZUKI, YOSHINORI ARIMOTO (Communications Research Laboratory, Koganei, Japan), AKIHIKO INOUE, HIDEKI KOBAYASHI (NEC Corp., Yokohama, Japan), and NAOFUMI OKUBO (Fujitsu Laboratories, Ltd., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1797-1802. refs

Copyright

A 43/38 GHz (mm-wave) bands satellite communications experimental system featuring GEO/LEO and GEO/GEO intersatellite communications and personal communications is discussed in light of detailed performance data on the electrical model of the mm-wave transponder. Attention is given to the state-of-the-art solid-state power amplifiers, low-noise amplifiers, and personal communications terminal employed in these experiments. O.C.

A92-55210#

DEVELOPMENT OF ONE-WAY RANGING SYSTEM FOR THE TR-1A ROCKET VEHICLE

HIDEHIKO MORI, JIRO KOCHIYAMA, MAKOTO MIWADA, TOSHIKI SATO (NASDA, Tokyo, Japan), TAKUJI MORITA, TERUO FUJIWARA (Nissan Motor Co., Ltd., Tokyo, Japan), and SHOJI UEHARA (Meisei Electric Co., Ltd., Kitasuma, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 2. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 587-593.

(AIAA PAPER 92-4417) Copyright

A simplified ranging system has been developed to measure the slant range throughout the trajectory of a small rocket. This system measures the time difference between a highly stable onboard time reference consisting of a temperature-controlled crystal oscillator TCXO and a time standard on the ground. The system multiplexes ranging pulses derived from the onboard time reference with PCM telemetry data, and transmits the resulting signal to the ground over the existing telemetry data link. This allows the slant range to be measured, and hence the flight path to be calculated, by using the ranging pulses in conjunction with the tracking angle output of the existing telemetry antenna. Thus, this system can be expected to become a back-up to trajectory tracking using the radar transponder. In the summer of 1991, the system was flight-tested on the TR-1A rocket, which is a small rocket developed by the National Space Development Agency of Japan (NASDA) for microgravity experiments. During the flight slant range data was obtained, and post-flight analysis showed this ranging system to be effective. Author

A92-56121

EVALUATION OF A IMU WITH OPTICAL FIBER GYROS IN DYNAMIC WINDTUNNEL TESTS

MINORU TAKIZAWA, SHUICHI SASA, MASAHIKO NAGAYASU (National Aerospace Laboratory, Chofu, Japan), HIROSHI KAJOKA, and TOSHIO IIZUKA (Hitachi Cable, Ltd., Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 540-543. In Japanese. refs

A study of dynamic windtunnel tests using a 5 percent cable-mounted model of the NAL spaceplane was carried out to identify aerodynamic parameters of the Spaceplane at National Aerospace Laboratory (NAL). In this study, an inertial measuring unit with optical fiber gyros, which will be installed on the model

and will be used to measure angular rates about three axes of the model, has been developed and evaluated in dynamic windtunnel tests. It is reported that the IMU has been used effectively in the control system of the model; however, the accuracy, resolution, and frequency response of the OFG-3 were insufficient for the dynamic windtunnel tests. Author

N92-19654# Meteorological Satellite Center, Tokyo (Japan).

IMPROVEMENT OF TELEMETRY WATCHING FUNCTION

SHIGETO MIURA IN: Meteorological Satellite Center Technical Note No. 20, 1990 p 85-97 Mar. 1990 In JAPANESE; ENGLISH summary Original contains color illustrations

Avail: CASI HC A03/MF A02

Command and Data Acquisition Station (CDAS) renewed the ground communication system in 1987. The new communication system began working in April 1988. After several months of working and finding some problems concerning telemetry watch, the watch screen of the control console was improved as follows: abbreviation of telemetry names were unified; figures of voltage and current, etc. were unified; and the order of abbreviated telemetry names were unified with subsystems. This improvement was done by renewing data base of telemetry watch systems. Author

N92-33583 DX Antenna Co. Ltd. (Japan).

DEVICE AND METHOD FOR AUTOMATICALLY TRACKING SATELLITE BY RECEIVING ANTENNA Patent

SUMITAKA UESHIN, inventor (to CISTI) 4 Apr. 1989 19 p

(CA-PATENT-1-252-194; INT-PATENT-CLASS-H01Q-3/02;

INT-PATENT-CLASS-H01Q-3/16;

INT-PATENT-CLASS-H01Q-3/18; CTN-91-60142) Avail:

Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC/MF

A method and a device for tracking a communication satellite using a parabolic antenna carried on a moving body are described. The method can significantly improve tracking accuracy. The antenna is first caused to scan the whole azimuth about a starting reference elevation until the received signal exceeds a first reference level. Thereafter, the antenna is driven so that its axis drafts a rectangular spiral on the celestial sphere until the received signal exceeds a second reference level. This scan search is repeated as a correction search when the received signal drops below the second reference level due to movement of the moving body. The system has a primary radiator located at the focus of the parabolic reflector and an auxiliary primary radiator located close to the main radiator so as to have a slight azimuthal deviation from the main radiator. The main and auxiliary level detectors are coupled to the main and auxiliary radiators. The primary control responds to the main signal level. The second control means is responsive to the difference between the main and auxiliary signal levels so that the difference maintains a predetermined polarity. The third control initiates corrective action when the main signal drops below a predetermined level. The three control means are included in a single microcomputer. CISTI

SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

A92-12434

THE DEVELOPMENT OF RENDEZ-VOUS AND DOCKING TECHNOLOGY FOR JAPANESE FUTURE SPACE SYSTEMS

YASUAKI TANIGUCHI, RYUJI SAKATA, KENJI OGIMOTO (Kawasaki Heavy Industries, Ltd., Gifu, Japan), OSAMU MIKI, and

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

SUMIHIRO UEDA (Kawasaki Heavy Industries, Ltd., Akashi, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. Research supported by NASDA, Institute of Space and Astronautical Science, and National Aerospace Laboratory. refs
(IAF PAPER 91-009) Copyright

The development of rendezvous and docking (RVD) technology to realize in-orbit servicing technologies such as the exchange of ORUs, the resupply of coolant and or/fuel and the construction of large space structures is presented. Studies on docking mechanisms, proximity sensors and a RVD system on board a small rocket are discussed. This system consists of various softwares and hardwares including a laser radar, an on-board computer, a proximity sensor, docking mechanisms, path planning, and navigation softwares. R.E.P.

A92-12453

STUDY OF LUNAR POLAR ORBITER

RYOICHI IMAI, TOSHIHIDE MAEDA, TAKAO ETO, KAZUO OHTA, YUTAKA KANEKO, and TSUTOMU IWATA (NASDA, Systems Engineering Dept., Tsukuba, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs

(IAF PAPER 91-034) Copyright

Two Lunar Polar Orbiter (LPO) systems and their sensors are described. One LPO is a two-ton-class remote sensing satellite which uses the high-resolution Lunar Mapping Imager (LMI), SAR, and the Laser Altimeter. The other LPO, a combination of the 1.5-ton class remote sensing satellite and a 0.5-ton class Landing Probe, employs the LMI, conventional RF radar altimeter, and ground-truth sensors. The designs of the subsystems are shown and operational scenarios are briefly addressed. C.D.

A92-12485

JEM TECHNOLOGY DEVELOPMENT

KUNIYUKI SHIRAKI, FUMIO OTSUKI, KAZUYUKI TASAKI, NAOKI SATO (NASDA, Tokyo, Japan), NOBUYUKI TOMITA, HIROJIROU SHIOZAWA, and NOBUJI NISHINO (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 14 p.
(IAF PAPER 91-076) Copyright

An overview is presented of the current status of the Japanese Experiment Module (JEM) and the major on-going technology developments. JEM is a multipurpose research and experiment laboratory in space to be permanently attached to the U.S. Space Station Freedom. The major elements of the laboratory are the pressurized module, the exposed facility, the experiment logistics module-pressurized section, the experiment logistics module-exposed section, and the remote manipulator system. Attention is given to the electrical power system, the environment control and life support systems, flight application software, and the payload attach mechanism. R.E.P.

A92-12562

A CONCEPTUAL STUDY ON A NEW STYLE LOGISTIC SERVICE VEHICLE

MITSUSHIGE ODA (NASDA, Tsukuba Space Center, Japan), KATSUMI KITO, and TAKAHIRO ITOH (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p.
(IAF PAPER 91-188) Copyright

A conceptual study of an in-orbit deployable reentry vehicle which can be used for logistic support and space experiments is reported. The vehicle has a deployable capsule shell which can be extended in orbit to deploy solar paddles, radiator, and manipulator arm. The subelements of these systems are described and the systems' major characteristics are listed. The concepts are also graphically depicted. C.D.

A92-12581

ORBIT DEMONSTRATION OF TWO-DIMENSIONAL DEPLOYABLE ARRAY INCLUDING HIGH VOLTAGE PHOTOVOLTAIC POWER GENERATION

HITOSHI KUNINAKA, MICHIOHITO NATORI (Institute of Space and Astronautical Science, Sagami, Japan), YOSHIHARU KAWAI (Toshiba Corp., Kawasaki, Japan), and SHINGO IKEGAMI (Nippon Electric Co., Ltd., Yokohama, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs

(IAF PAPER 91-224) Copyright

The development of a 2D deployable high voltage (2D/HV) solar array experiment to demonstrate repetitive deployment/retraction of a plane structure and high voltage photovoltaic power generation in space is presented. Flight objective of 2D/HV is to demonstrate fundamental technologies on a high power solar array in LEO. The 2D experiment will advance the space membrane structure from line to plane and the HV experiment will conduct high voltage power generation utilizing solar cells in a space environment. R.E.P.

A92-14730

SCALE MODEL DEVELOPMENT OF ASSEMBLING TYPE SPACE ANTENNA

YOSHIKI SUZUKI, TETSUO TAKAHASHI, MASATO TANAKA, TAKASHI IIDA (Communications Research Laboratory, Koganei, Japan), SEIJI YOKOTA (NEC Corp., Yokohama, Japan), and KAZUO OHSHIMA (Toshiba Corp., Komukai Works, Kawasaki, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs

(IAF PAPER 91-314) Copyright

This paper describes the development of assembling type antenna scale models which are designed to be constructed by using manipulator arm. The assembling type antenna has possible advantages to achieve high accuracy in reflector surface construction and is appropriate for the high frequency application, comparing deployable type antenna. After some trade-off studies, two types of antennas which have unique coupling mechanisms were selected. Using these smart mechanisms, construction using manipulator instead of using dangerous extra vehicular operation became possible. Author

A92-14731

A MODULAR APPROACH TO BUILD A LARGE SPACE ANTENNA

JIN MITSUGI and TETSUO YASAKA (NTT, Radio Communication Systems Laboratory, Yokosuka, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs

(IAF PAPER 91-315) Copyright

Large deployable mesh antenna composed of independently manufactured and tested modules is presented and its feasibility for a 10-m aperture, C-band application is examined from the surface accuracy point of view. The required accuracy of a module under possible imperfection between modules is derived. The tensions in the mesh surface to achieve the module accuracy is elicited by modeling the mesh with an equivalent cable network. Results give a mesh surface that could be considered as flat among the shaping cable network. Author

A92-14732

STRUCTURAL DESIGN OF A 10 M DIAMETER TENSION TRUSS ANTENNA

KORYO MIURA, TADASHI TAKANO (Institute of Space and Astronautical Science, Sagami, Japan), TOSHIO INOUE, and KAZUO TANIZAWA (Mitsubishi Electric Corp., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs

(IAF PAPER 91-316) Copyright

A 10m diameter tension truss antenna for the ISAS's engineering test satellite Muses-B will be launched in 1995. This antenna will be used for the VLBI Space Observatory Program (VSOP). The required surface accuracy of the antenna is 0.5 mm rms. Muses-B will be launched by M-5, and the envelope's diameter is less than 2200 mm. Since the effectiveness of the present design depends heavily on the cable materials and stiffness, the study was performed to find the best choice of cable materials

with consideration for such factors as thermal deformation, slackening, and available extendible mast stiffness. It is shown that the mesh surface approximation error is less than 0.3 mm rms, that the effect of stiffness change by the radio active ray on the surface accuracy is negligible, and that the effect of moisture loss is large but can be canceled by the initial offset. Author

A92-15258
DYNAMICAL ANALYSIS OF THE DEPLOYABLE WIRE AND PROBE ANTENNA SYSTEMS ABOARD THE DUAL-SPIN SATELLITE GEOTAIL

Y. MORITA, M. HINADA (Institute of Space and Astronautical Science, Sagami, Japan), A. KITSUI, and Y. TAKEMOTO (Hitachi, Ltd., Yokohama, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 12 p. refs (IAF PAPER 91-352) Copyright

In order to investigate the geomagnetic tail region of the magnetosphere, a joint project, called Geotail, is planned between Japan and NASA. The high degree of flexibility of the wire antennas and their dimensions can lead to undesirable wire vibrations as well as satellite-attitude perturbations through in-orbit events such as antenna deployment, satellite spinup, despin motor operation, attitude and orbital maneuvers, resulting in distortion of the attitude-control accuracy and the scientific observation environment. In the study, the dynamics of dual spinning systems with highly flexible deployable wire antennas has been formulated in a relatively general manner. The associated extensive parametric analysis reveals the interactions among the attitude, orbital, and vibrational dynamics as affected by wire deployment, mast extension, and despin antenna operation as well as attitude and orbit maneuvers. Author

A92-17831#
THERMOCHEMICAL AND AERODYNAMIC PROBING AND CFD VALIDATION BY A RE-ENTRY CAPSULE EXPERIMENT

Y. INOUE, Y. WATANABE, Y. WADA (National Aerospace Laboratory, Chofu, Japan), and T. AKIMOTO (NASDA, Tsukuba, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 11 p. refs (AIAA PAPER 91-5045) Copyright

The paper describes the NASDA/NAL joint Orbital Reentry Experiment (OREX) and presents its developmental status, with special attention given to the experiments being developed by NAL. These will include plasma electron-density measurements, enhanced-heat-flux measurements by atomic recombination, low drag measurements, high-altitude surface-pressure measurements, and heat blockage performance measurements of a small ablator block. The computational fluid dynamics (CFD) technologies for the H-II Orbiting Plane and the Space Plane programs which are being developed for the NAL OREX mission are described. Comparisons of experiments with CFD are used to modify and confirm the design specifications. I.S.

A92-17877
THERMAL DESIGN EVALUATION OF ON-BOARD LARGE DEPLOYABLE ANTENNA

HIROAKI TSUNODA, KATSUHIKO NAKAJIMA, and AKIHIRO MIYASAKA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 504-512. In Japanese. refs

A future multibeam communication satellite requires a large deployable antenna which has a total length of about 9 m, including two large main reflectors and a tower. Thermal balance test for such a large-sized antenna system are limited by the volume of a space simulation chamber. The deployment mechanisms cannot support the reflectors without damage under gravitational conditions. In order to overcome these problems, a two-step thermal design verification method is devised. First, the antenna component thermal analytical model was verified by each component test in critical test cases. Next, the antenna system thermal analytical model was verified by a system test. The antenna system test is performed by using supporting structures which

support the hardpoints of each main-reflector in order to minimize the gravity force to the antenna deployment mechanisms.

Author

A92-17878
COOPERATIVE DYNAMIC CONTROL FOR DUAL-ARM FLYING ROBOT IN PROXIMITY MANEUVER

TOSHIKI IWATA, YOSHITSUGU TODA, and KAZUO MACHIDA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 513-521. In Japanese. refs

This paper presents cooperative dynamic control methods for a dual-armed free-flying robot in proximity maneuvering. A 2D space robot model equipped with thrusters and dual three-degree-of-freedom arms is considered. First, the equation of motion is derived by Kane's method. Secondly, the method is adapted to point-to-point resolved motion acceleration control. Two cases are considered: control with thrusters, and without thrusters; these are then compared. Third, it is inappropriate to use thrusters for controlling the attitude because of the amount of propellant required. If a single arm is enough for a task, the other arm is available to control the attitude. When the robot avoids an obstacle or chases a moving target, point-to-point control is insufficient. The control law is extended to follow an arbitrary trajectory. Aligning with a target axis and chasing a moving target are demonstrated.

Author

A92-18520
IN-ORBIT PERFORMANCE OF BROADCASTING SATELLITE-3A

TSUNENORI AKANUMA, FUMIO YAMAGATA, HARUAKI ITAGAKI, MAKOTO SASAKI, and SHUNICHI KAWATA (NASDA, Communications and Broadcasting Satellite Group, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs (IAF PAPER 91-510) Copyright

The design and the operational characteristics of the Broadcasting Satellite-3 (BS-3), which is the third-generation Japanese direct broadcasting mission consisting of BS-3a and BS-3b satellites, are described. The BS-3 mission is supplying three color television channels to Japan, with domestic individual receivers amounting to 4 million households. Results of in-orbit tests on BS-3a showed that the performance of BS-3a, which was launched in August 1990, is satisfactory except for high-voltage bus subsystem; attitude control including the antenna pointing and rotating performed normally. The BS-3b is being prepared for launch in August 1991. I.S.

A92-18605
DYNAMICS OF AN ANTENNA POINTING CONTROL SYSTEM WITH FLEXIBLE STRUCTURES

MASAZUMI UEBA (NTT, Yokosuka, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 14, Nov.-Dec. 1991, p. 1123-1128. Previously cited in issue 24, p. 3844, Accession no. A90-53032. refs Copyright

A92-20766
ANALYTICAL EVALUATION OF LATTICE SPACE STRUCTURES FOR ACCURACY

HIROSHI FURUYA (Nagoya University, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, Jan. 1992, p. 280-282. refs Copyright

An effort is made to analytically formulate the arbitrary stochastic effects of member-length errors on lattice space structures' accuracy. The comprehensive formulation presented is based on the vector subspaces associated with the dominant matrix derived from the equilibrium and covariance matrices of the structure. It is shown that the stochastic analysis of the lattice-type structures can be treated as a simple eigenvalue problem, and that the invariant of the dominant matrix plays an important role in estimating the structural errors. O.C.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

A92-21829

FUNDAMENTAL STUDY ON TWO PHASE FLUID LOOP FOR THERMAL CONTROL SYSTEM IN FUTURE SPACE PLATFORMS

KOICHI CHIBA, SHINYA SUGURI, HIDEAKI TOKUTOMI, and SHINTAROU ENYA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs

(SAE PAPER 911410) Copyright

Since 1987, the liquid-gas two-phase fluid loop and several kinds of cold plates in order to provide large platforms in the future have been studied. This report describes the following in connection with the two-phase fluid loop: (1) an outline of the recent trial manufacture of the two-phase fluid loop provided with a bellows-type flow control system, which can be used in space; (2) new type cold plates featuring porous fin; and (3) tests results confirming that the loop and heat exchangers have adequate operational characteristics. Author

A92-28144

WAVE-ABSORBING CONTROL FOR FLEXIBLE STRUCTURES WITH NONCOLLOCATED SENSORS AND ACTUATORS

HIRONORI FUJII, TOSHIYUKI OHTSUKA, and TSUTOMO MURAYAMA (Tokyo Metropolitan Institute of Technology, Hino, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, Mar.-Apr. 1992, p. 431-439. Previously cited in issue 23, p. 3631, Accession no. A89-52714. refs Copyright

A92-29930#

DEVELOPMENT FOR A PRECISION LARGE DEPLOYABLE ANTENNA FOR THE SPACE VLBI

KUNITO OHKUBO, TAKAHIKO NODA, OSAMI ISHIDA, KAZUO YAMAMOTO (Mitsubishi Electric Corp., Kamakura, Japan), KORYO MIURA, and TADASHI TAKANO (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1552-1559. refs (AIAA PAPER 92-2011) Copyright

Japan's Institute of Space and Astronautical Science has scheduled a 1995 launch for the Muses-B astronomical satellite, which will be used in conjunction with ground-based radio telescopes to create a VLBI system suitable for high-resolution studies of distant galaxies. Muses-B will deploy a 10-m diameter radio telescope antenna in orbit, and operate at 22, 5.0, and 1.6 GHz. A displaced-axis Cassegrain antenna is employed whose surface-accuracy design goal is less than 0.5 mm rms. Attention is given to initial system tests conducted with a quarter-scale model of the antenna. O.C.

A92-32193

THERMAL DESIGN VERIFICATION OF A LARGE DEPLOYABLE ANTENNA FOR A COMMUNICATIONS SATELLITE

H. TSUNODA, K. NAKAJIMA, and A. MIYASAKA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 29, Mar.-Apr. 1992, p. 271-278. Previously cited in issue 18, p. 3075, Accession no. A91-43377. refs Copyright

A92-33801

THIRTEENTH SCIENTIFIC SATELLITE MUSES-A 'HITEN' AND 'HAGOROMO'

KUNINORI UESUGI, JUN'ICHIRO KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan), MASAYUKI KAMIMURA, NOBORU MURANAKA (NEC Corp., Space Development Div., Yokohama, Japan), AKIHIKO KIMURA (NEC Aerospace Systems, Ltd., Yokohama, Japan), MASASHI UO (NEC Corp., Space Development Div., Yokohama, Japan), MASAFUMI

KIMURA, and KIMIE TANAKA (NEC Aerospace Systems, Ltd., Yokohama, Japan) NEC Technical Journal (ISSN 0285-4139), vol. 44, no. 9, Oct. 1991, p. 34-42. In Japanese. Copyright

The thirteenth scientific satellite HITEN and miniaturized satellite HAGOROMO have been developed for the main missions of acquiring swingby technology and an experiment on injecting the orbiter into orbit around the moon, respectively. HITEN and HAGOROMO were successfully launched on January 24, 1990. At the first swingby, HAGOROMO was injected into orbit around the moon after separation from HITEN. HITEN accomplished missions such as change of trajectory by lunar swingby, and aerobraking experiment. Author

A92-34425#

SEMI-ACTIVE VIBRATION SUPPRESSION OF TRUSS STRUCTURES BY COULOMB FRICTION

JUNJIRO ONODA and KENJI MINESUGI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1488-1496. refs (AIAA PAPER 92-2270) Copyright

The present, dry friction-based semiactive vibration-suppression method for truss structures adaptively controls the normal forces for the frictions, according to vibration condition. The system is always stable, and the control is suitable for local implementation. Numerical simulations of truss structures with multiple variable-friction members show that this primitive control precludes the difficulties associated with frictional damping while retaining robustness. Attention is given to a vibration-suppression experiment that demonstrates the feasibility of this approach. O.C.

A92-34444#

EXPERIMENTAL STUDY ON DYNAMIC INSTABILITIES OF A COLUMN THRUSTED BY NONCONSERVATIVE FORCES

KEN HIGUCHI (Tokyo Denki University, Hatoyama, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1670-1677. refs (AIAA PAPER 92-2331) Copyright

Attention is given to the dynamic instability of a column subjected to a nonconservative force. The column is proposed to simulate the dynamic instability phenomena of a portion from the nodal point to the trailing end of an accelerated free-free column subjected to a tangential follower force. An FEM method is applied to determine the properties of the elastically supported-free column with a nonuniform axial force before the experiment. The adjoint system of the column is also derived, since the experiment is carried out by using the equivalency of the boundary conditions of the adjoint system. The experimental system showed flutter phenomena, and the experimental results agreed well with the FEM solutions for a fluttering free-free column. P.D.

A92-35605

OUTLINE OF THE EXPERIMENT LOGISTICS MODULE, THE EXPOSED SECTION OF THE JAPANESE EXPERIMENT MODULE (JEM)

KAZUYOSHI KAWASAKI, EIICHI HASHIMOTO, and KAZUHIKO KAMESAKI (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 5, 6. In Japanese.

The performance and functions of the ELM, the exposed section of the Japanese Experiment Module (JEM), are presented. The payload attaching mechanism is used and the ES control unit and equipment exchange unit are discussed. The standard payload is discussed. Y.P.Q.

A92-35606**FUNDAMENTAL DESIGN OF THE EXPOSED FACILITY OF THE JAPANESE EXPERIMENT MODULE (JEM)**

TOSHIHIKO FUJITA, EIICHI HASHIMOTO, KAZUHIKO KAMESAKI, KAZUYOSHI KAWASAKI, and M. TAKAI (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 7, 8. In Japanese.

The exposed facility (EF) system design and configurations of the EF are outlined. The payload equipment exchange unit (EEU) and orbital replacement unit (ORU) are introduced. The communication control system is also discussed. Y.P.Q.

A92-35608**OUTLINE OF THE ELECTRIC POWER AND COMMUNICATION CONTROL SYSTEMS OF THE EXPOSED FACILITY IN THE JAPANESE EXPERIMENT MODULE (JEM)**

KAZUHIKO KAMESAKI, M. TAKAI (NASDA, Tokyo, Japan), TADASHI M. ORIYA, KENJI HONDA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), T. KIKUCHI, and S. NISHIDA (Ishikawa System Technology, Inc., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 11, 12. In Japanese.

The configurations of the communication control system of the exposed facility (EF) in the Japanese Experiment Module (JEM) are presented. The electric power supply system of EF-JEM is given and the payload interface unit is discussed. Y.P.Q.

A92-35609**OUTLINE OF THE EXPOSED FACILITY STRUCTURES OF THE JAPANESE EXPERIMENT MODULE (JEM)**

KAZUHIKO KAMESAKI, M. TAKAI (NASDA, Tokyo, Japan), KENJI SAKANO, TAKANE WATANABE, T. SAKADA, T. OJIMA, A. KITAMURA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and EIJI KINOCHI (Ishikawa System Technology, Inc., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 13, 14. In Japanese.

The design of the exposed facility (EF) of the Japanese Experiment Module (JEM) is presented. The development of the engineering model and flight model are discussed. Y.P.Q.

A92-35610**OUTLINE AND DISCUSSION OF THE COOLING LOOP OF THE HEATING CONTROL SYSTEM IN THE EXPOSED FACILITY OF THE JAPANESE EXPERIMENT MODULE (JEM)**

KAZUHIKO KAMESAKI, M. TAKAI (NASDA, Tokyo, Japan), UICHI IMACHI, KATSUTO INOUE (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and T. KATO IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 15, 16. In Japanese.

A92-35611**STATUS OF THE MODULE PRESSURIZED SECTION DEVELOPMENT OF THE JAPANESE EXPERIMENT MODULE (JEM)**

F. OTSUKI, YUICHI YAMAURA (NASDA, Tokyo, Japan), M. ASANO, and NOBUO FUKUDA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 17, 18. In Japanese.

The design and main functions of the pressurized section of the Japanese Experiment Module (JEM) are introduced. The electric power control, heat transfer, communication and data processing, and protection from debris are addressed. Y.P.Q.

A92-35624**ADAPTIVE CONTROL OF LARGE SPACE STRUCTURES AND SENSOR COLLOCATION**

R. OGURA, I. TANAKA, and YUZO SHIMADA (Nihon University,

Funabashi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 43, 44. In Japanese. refs

The equations of motion for large space structures (LSS) are considered. Adaptive control design is given and sensor collocation is presented. Numerical simulations are discussed. Y.P.Q.

A92-35625**DESIGN ANALYSIS OF A CONTROL SYSTEM OF RENDEZVOUS AND DOCKING**

TOSHIMASA YOSHIDA, H. KATO (Mitsubishi Electric Corp., Japan), and YASUFUMI WAKABAYASHI (NASDA, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 45, 46. In Japanese.

The rendezvous and flight control system for a spacecraft is presented. The design of the flight control system is given and docking control simulations are discussed. Y.P.Q.

A92-35626**THE SPACE SHUTTLE RETRIEVAL ATTITUDE CONTROL FOR THE SPACE FLYER UNIT (SFU)**

KEIKEN NINOMIYA, T. NISHIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan), MASAO SATO, H. KURIHARA, and T. YAMAGUCHI (Mitsubishi Electric Corp., Kamakura, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 47, 48. In Japanese. refs

An experiment on the Space Shuttle retrieval attitude control for the space flyer unit (SFU) is described. The near field operational tasks are discussed. The reaction control system (RCS) for the retrieval of the SFU is discussed. Y.P.Q.

A92-35627**THE BASIC CHARACTERISTICS OF MISSION FUNCTION (MF) CONTROL**

HIRONORI FUJII (Tokyo Metropolitan Institute of Technology, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 49, 50. In Japanese. refs

Liapunov methods are used for the mission function (MF) control. The linear quadratic regulator for MF is analyzed, and a scheme for the dynamics of large space structures is presented. Y.P.Q.

A92-35635**STUDY ON THE CONCEPT OF THE MANNED SERVICE PLATFORM (MSPF)**

Y. MINAMI, HIDEICHI ISHII, RYUICHI OKAHASHI, and A. KIMURA (NEC Corp., Yokohama, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 73, 74. In Japanese.

The performance and configurations of the manned service platform (MSPF) are presented. The designs of the electric power system, attitude control system, and orbital service of the MSPF are emphasized. The safety of the MSPF and its management are addressed. Y.P.Q.

A92-35636**STUDY ON THE CONCEPT OF THE PRESSURE SERVICE CABIN (PSC)**

S. UMESATO (NEC Corp., Yokohama, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 75, 76. In Japanese.

The functional requirements of pressure service cabin (PSC) of the manned service platform (MSPF) is presented. Its weight, electric power and communication data are discussed. The structural design of the PSC is shown. Y.P.Q.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

A92-35637

PROTECTION STRUCTURES AGAINST METEORITES AND DEBRIS FOR THE JAPANESE EXPERIMENT MODULE (JEM)

FUMIO OTSUKI, K. ARAI, I. TAZAKI (NASDA, Tokyo, Japan), FUMIO SUEHIRO, H. OGASAWAHARA, and M. TOYAMA (Mitsubishi Electric Corp., Kamakura, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 77, 78. In Japanese. refs

The design of protection structures against meteorites and debris is discussed. Design data analysis and collision tests are addressed. Y.P.Q.

A92-38203

SPACE ROBOTS

KAZUO TSUCHIYA (Osaka University, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 14-20. In Japanese. refs

Space robot technology for future space activities is presented. The free flying robot serving a space platform is emphasized. Analysis of the characteristics of the robot in space is presented, and the testing facilities are discussed. Y.P.Q.

A92-38204

CHARACTERISTICS OF SPACE STRUCTURES AND THEIR DESIGN CONSIDERATIONS

MICHIHIRO NATORI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 21-31. In Japanese. refs

Novel design methodologies are being developed to meet the unique requirements of large space-based structural systems for such applications as space colonies and solar power satellites. Efforts have concentrated on innovative means for the control of these highly flexible structures by autonomous/distributed means. This essential flexibility has compelled consideration of such structures' design by means of analogies to such natural forms as flowers and silkworm cocoons. O.C.

A92-38500#

JAPANESE EXPERIMENT MODULE (JEM) PROGRAM OVERVIEW

KAZUHIKO YONEYAMA, KUNIAKI SHIRAKI (NASDA, Tokyo, Japan), YOSHIO ONO, and YUZO ICHIMARU (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 8 p. Research supported by Ishikawajima-Harima Heavy Industries Co., Ltd. and Toshiba Corp.

(AIAA PAPER 92-1309) Copyright

JEM is a multiple-purpose scientific research laboratory which will be launched by the Space Shuttle and assembled in space to be attached permanently to the Space Station Freedom core. The five principal elements of JEM are the Pressurized Module, the Exposed Facility, the Remote Manipulator System, the Experiment Logistics Module-Pressurized Section, and the Experiment Logistics Module-Exposed Section. The paper presents an overview of the current status of the JEM design activities and describes the system's technology-development tests. Diagrams of JEM configuration and of its internal structure are presented together with the schedule of the developments of JEM and of its subunits, which will culminate in the JEM flight scheduled for 1998. I.S.

A92-39257

OPTIMAL CONFIGURATION CONTROL OF AN INTELLIGENT TRUSS STRUCTURE

Y. MUROTSU, K. SENDA, and K. HISAJI (Osaka Prefecture, University, Sakai, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 157-175. refs

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This paper is concerned with the optimal configuration and the configuration control of the intelligent truss structures composed of a truss type mechanism. First, the problem to find the optimal configuration is solved by minimizing the performance index corresponding to the demanded task. The computational effort is huge, and the method can only be used for finding the optimal configuration. Next, two efficient methods are proposed for the configuration control under the relaxed conditions of optimality. The validity of the proposed methods is demonstrated through numerical simulations. Author

A92-39261

ELECTRICAL SHOCK ABSORBER FOR DOCKING CONTROL SYSTEM

SHOHEI NIWA, MASAYUKI SUZUKI, RYOICHI HIBINO, and MITSUO ITO (Nagoya University, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 332-348. refs

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Results are reported from a preliminary experimental study examining an electromechanical actuator for a docking system in space, with emphasis on the attenuation and shock-absorbing characteristics of the actuator. A laboratory prototype of an electromechanical docking system which uses a sonar ranging system as a substitute for the laser range sensor and is controlled by a microprocessor is presented. The configuration of the experimental system consists of a rack and pinion gear actuator, a servo motor, sensors, a digital controller and an air-lifted docking target. For the design of the attenuator controller, the linear quadratic Gaussian (LQG) control design method is applied. For the purpose of attenuation on a specified frequency band, the application of a frequency-weighted LQG method and frequency domain method such as H2 and H-infinity control theory are considered. P.D.

A92-39267

ON DAMPING ENHANCEMENT OF LSS COUPLED WITH THE ANTENNA POINTING SYSTEM

M. TANAKA, K. HIRAKO (Toshiba Corp., Komukai Works, Kawasaki, Japan), S. UENO (Yokohama National University, Japan), T. KIDA, and I. YAMAGUCHI (National Aerospace Laboratory, Chofu, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 510-524. refs

Copyright

Results of an experimental study tracing the dynamical interaction between the antenna pointing system (APS) and the structural vibration of large space structures (LSS) are presented. The important role of the damping enhancement of the structure is considered and demonstrated. From many case-runs for various parameter values of APS control gain, the numerical analytical results correspond to the results of the experiment with sufficient accuracy. By increasing the proportional gain, $K_{sub P}$, excellent pointing performance is attained. The system becomes unstable for excessively large $K_{sub P}$ because of the dynamical interaction with the structural vibration. The damping enhancement of the structure by the proof-mass actuator can recover system stability. P.D.

A92-39276

APPLICATION OF FUZZY CONTROL TO TRACKING FOR DOCKING OPERATION OF AN ADAPTIVE SPACE STRUCTURE

YUJI MATSUZAKI, HIROTO HOSODA, and YOSHIYASU HAYAKAWA (Nagoya University, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 792-803. refs

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This paper describes an application of fuzzy logic control to an experimental simulation of tracking of space structures. The test was made using a two-dimensional truss-type structure with

variable geometries constructed for rendezvous and docking test. The bending-deformation modules of the structure were controlled by the signal from the optical tracking sensor while the docking target was moving vertically at a constant speed between two specified points. Based on triangle-shaped membership functions and partition with three terms, two fuzzy inference approaches were applied together with the center of area method to defuzzification. This preliminary test suggests that the application of fuzzy logic control will be effective in rendezvous and docking of the space structures. Author

A92-39901
EXPERIMENT OF A NONCOLLOCATED CONTROLLER FOR WAVE CANCELLATION

HIRONORI FUJII and TOSHIYUKI OHTSUKA (Tokyo Metropolitan Institute of Technology, Hino, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 741-745. refs
 Copyright

Wave-absorbing control for vibration suppression of flexible space structures is demonstrated experimentally. The experimental model is a hung flexible beam with a sensor and a noncollocated torque actuator. The wave-absorbing control employs partial differential equations as the mathematical model of structural dynamics, and the controller can be designed without any use of the modal expansion. Thus, the control is free from the crucial truncation effect. The structural vibration is expressed in terms of propagating disturbances in the frequency domain. The control forces are applied to eliminate outgoing waves at the boundaries of the structure. The controller is implemented in the form of a nonrecursive digital filter. Details of the controller implementation are discussed, including the digital filter as a compensator, filter truncation, and the hardware. Experimental results show satisfactory performance of the controller and good agreement with the performance predicted analytically. Author

A92-42063
SPACE STRUCTURES DESIGN CRITERIA FOR METEOROID-DAMAGE TOLERANCE

HIROSHI OTANI (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: Annual Reliability and Maintainability Symposium, Orlando, FL, Jan. 29-31, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 190-195. refs
 Copyright

Design criteria are presently formulated for the wall thickness of space structures, with a view to rendering them tolerant to micrometeoroid-impact damage. After maximum expected meteoroid damage is stochastically estimated by means of Poisson analysis that yields the cumulative distribution function for impact penetration depth, the cumulative distribution function of mass must be replaced by that of the penetration depth. The expected penetration depth for a space structure is furnished as a function of total structural area. Study results are used to define design criteria for manned space structures with the requisite safety and reliability requirements. O.C.

A92-45402
A NEW TWO DEGREES-OF-FREEDOM ACTUATOR USED FOR VIBRATION CONTROL OF LARGE SPACE STRUCTURES

OSAMU OKAMOTO, TERUOMI NAKAYA, SEIZO SUZUKI (National Aerospace Laboratory, Chofu, Japan), KENJI OGIMOTO, YASUAKI TANIGUCHI, HAJIME SAKAMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan), GOJI IBA, SOTOMITSU HARA, and MAKOTO HAMADA (Nachi-Fujikoshi Corp., Toyama, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 315-324. refs
 (SAE PAPER 912000) Copyright

A new two-degrees-of-freedom actuator called 'superprecision positioning device' (SPD) was developed, which converts rotational motion to translational motion without cams or link mechanisms.

Experimental results are presented demonstrating an efficient control of three-dimensional vibrations of a large free-standing flexible frame-type structure by using the SPD as an active damping enhancer. I.S.

A92-47099
A FEATURE OF THE MF (MISSION-FUNCTION) CONTROL

HIRONORI FUJII (Tokyo Metropolitan Institute of Technology, Hino, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 35, no. 107, May 1992, p. 14-26. refs

A mechanical feature of the Mission-Function (MF) Control is studied in this paper. The MF Control is a control algorithm compatible with the fundamentals of mechanics in a dynamical system, and employs a 'mission function'. The mission function is a Liapunov function which includes such mechanical information in the system as the Hamiltonian, and also a generalized energy to improve performance of the controller. This paper presents in a general way the necessary conditions for the MF control. It is also shown that application of the MF control algorithm reduces to designing an optimal regulator for the dynamical system. Two examples applying the MF control are shown through use of a numerical simulation. Author

A92-47493
DEPLOYMENT/RETRIEVAL CONTROL OF A TETHERED SUBSATELLITE UNDER AERODYNAMIC EFFECT OF ATMOSPHERE

HIRONORI FUJII, KENTAROH KOKUBUN, KENJI UCHIYAMA, and TSUYOSHI SUGANUMA (Tokyo Metropolitan Institute of Technology, Hino, Japan) Journal of the Astronautical Sciences (ISSN 0021-9142), vol. 40, no. 2, Apr.-June 1992, p. 171-188. refs

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This paper studies the control problems of deployment and retrieval of a tethered subsatellite system taking into account the aerodynamic drag of the atmosphere. The Mission-Function control algorithm is applied to the control problem and the drag effect is explicitly included into the control algorithm. The control algorithm is also managed to accelerate the process of control in accordance with situations of deployment or retrieval of the subsatellite. Results of numerical simulation show excellent control performance of deployment and retrieval of the tethered subsatellite under the effect of aerodynamic drag. Author

A92-47886#
CONTROL TEST RESULTS OF A TWO-PHASE FLUID LOOP SYSTEM MODEL

T. MIYAJI, K. MIMURA, M. KOMORI (Toshiba Corp., Tokyo, Japan), M. FURUKAWA, and Y. ISHII (NASDA, Tsukuba, Japan) AIAA, Thermophysics Conference, 27th, Nashville, TN, July 6-8, 1992. 11 p. refs

(AIAA PAPER 92-2912) Copyright

Control algorithm for a two-phase fluid thermal management system is constructed and tested with a development model of 5 kW heat rejection. An approach of 'constant quality at evaporator exit' for flow rate control is used, based on the dynamic performance of the development model. Test results demonstrate good controllability of the control algorithm. R.E.P.

A92-52084#
ANTENNA POINTING CONTROL SYSTEM USING A LQG CONTROLLER FOR A LARGE ANTENNA REFLECTOR

MASAZUMI UEBA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: 1992 AIAA/AAS Astrodynamics Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 300-306. refs

(AIAA PAPER 92-4514) Copyright

This paper describes an antenna pointing control system using a Linear Quadratic Gaussian (LQG) controller for a 10 m class antenna reflector. The control performances of two regulators are investigated from the viewpoint of pointing accuracy and shape

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accuracy. The effects of the flexibility of the antenna reflector and the uncertainties of the disturbance torque on those accuracies are clarified. Author

A92-53004

SPACECRAFT CHARGING IN THE SPACE ENVIRONMENT

HARUHISA FUJII and HIRONOBU NISHIMOTO (Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 463, 1992, p. 413-423. In Japanese. refs

The spacecraft charging at high altitude (SCATHA) phenomenon and its effects are presented. The ground simulation of the spacecraft charging is discussed, and the structure of the satellite surface potential monitor (SSPM) carried by SCATHA satellite is described. The passive and active charging control technologies are addressed, and the LEO spacecraft charging phenomenon is also discussed. Y.P.Q.

A92-53528

NONLINEAR ELASTIC BEHAVIOR OF AN INITIALLY CURLED TETHER

KEN HIGUCHI and JINZO NAGAIRO (Tokyo Denki University, Hatoyama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 579-584.

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The effect of nonlinear elasticity and geometry is critical during the first stages of the extension of a satellite tether. The behavior of such a tether is studied experimentally in this paper in order to obtain data on the mechanical and geometrical properties of coiled tethers for a subsequent analysis. The experiment has clarified the nonlinear and time-dependent characteristics of a tether, showing the relationships between the initial curvature, the elastic and viscous moduli of the coiled deformation under a tensile force, and the force required to let out the tether from the reel. It is also shown that bending and torsion can be interchanged spatially under some circumstances, and that the coiled deformation shows a geometrical creep under a tensile force. Author

A92-53529

A NOTE ON THE ACCURACY ADJUSTMENT OF REFLECTOR STRUCTURES

KOJI SEKINE (NEC Corp., Space Development Div., Yokohama, Japan), MICHIOHORI NATORI, YASUYUKI MIYAZAKI (Institute of Space and Astronautical Science, Sagami-hara, Japan), and YOSHIHIDE KATO (NEC Corp., Space Development Div., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 585-592. refs

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A concept for an active accuracy adjustment of reflector surfaces by changing the element boundary planar shape is studied. The effectiveness of the concept is demonstrated by a linear and nonlinear deflection analysis of initially curved beam strips. The analysis shows that the surface accuracy error of a parabolic strip deformed by thermal distortion, which is of primary significance in space, can be greatly improved by a slight change of the element boundary. C.D.

A92-53530

DEPLOYMENT/RETRACTION SUPPORT MECHANISM OF DTB (DEPLOYABLE TEST BED)

SEISHIRO KIBE (National Aerospace Laboratory, Chofu, Japan), TOHRU GYOGI, HIROSHI TAMURA, YOHKO WATABE, and HIDEHIKO TAMAOKI (Nissan Motor Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 593-598. refs

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Deployable Test Bed (DTB) is a one-dimensionally deployable truss structure which serves for missions on the Space Station requiring large field of view, vast working area and avoidance of

contamination from/to the Space Station core base. In order to conduct repeated deployment and retraction operations for exchanging mission payloads, DTB needs some kind of mechanism which automatically supports those operations. This paper describes the results of trial production of a tension-rod-type truss structure and its support mechanism for deployment/retraction operation. Author

A92-53531

DEPLOYABLE MODULAR MESH ANTENNA - CONCEPT AND FEASIBILITY

JIN MITSUGI and TETSUO YASAKA (NTT, Satellite Communication Systems Laboratory, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 599-604. refs

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The feasibility of a 10m aperture deployable modular mesh antenna is evaluated by integrating the results of a statistical surface accuracy estimation and of surface shape adjustment experiments. It has been clarified that by combining seven 4m aperture modules, a 10m aperture deployable modular mesh antenna can be constructed, preserving the surface accuracy that is applicable to C band mission. Author

A92-53532

DEVELOPMENT OF A PRECISION LARGE DEPLOYABLE ANTENNA

YOJI IWATA, KAZUO YAMAMOTO, TAKAHIKO NODA, YASUO TAMAI, TAKASHI EBISUI (Mitsubishi Electric Corp., Kamakura, Japan), KORYO MIURA, and TADASHI TAKANO (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 605-610. refs

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This paper describes the results of a study of a precision large deployable antenna for the space VLB satellite 'MUSES-B'. An antenna with high gain and pointing accuracy is required for the mission objective. The frequency bands required are 22, 5 and 1.6 GHz. The required aperture diameter of the reflector is 10 meters. A displaced axis Cassegrain antenna is adopted with a mesh reflector formed in a tension truss concept. Analysis shows the possibility to achieve aperture efficiency of 60 percent at 22.15 GHz and surface accuracy of 0.5 mm rms. A one-fourth scale model of the reflector has been assembled in order to verify the design and clarify problems in manufacturing and assembly processes. Author

A92-53533

RESEARCH ON A REFLECTOR STRUCTURE COMPOSED OF INFLATABLE ELEMENTS

SUMIO KATO (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), TOKIO OHNISHI (Kawasaki Heavy Industries, Ltd., Akashi, Japan), OSAMU MURAGISHI (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), and MICHIOHORI NATORI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 611-622. refs

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This paper presents recent results of research on a modularized inflatable reflector structure for high precision reflector missions in the relatively near future. The structure consists of inflatable elements and a back-up structure. An appropriate reflector system including inflatable elements and a back-up structure is presented from the various viewpoints of technology development. Some fundamental characteristics of surface accuracy of inflatable elements are studied. Results of rigidization tests of inflatable elements, interface test of inflatable elements, and back-up truss, etc. are described. Author

A92-53535* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ADAPTIVE STRUCTURES TO ENABLE GROUND TEST VALIDATION OF PRECISION STRUCTURES

BEN K. WADA, JAMES F. FANSON, GUN-SHING CHEN, and CHIN-PO KUO (JPL, Pasadena, CA) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 629-634. refs

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The use of analytical models and ground-based experimental validation of precision space structures is addressed. The application of adaptive structures to such validation of precision space structures is addressed, with the focus on adaptive truss structures. C.D.

A92-53536

AN EXPERIMENTAL STUDY ON VIBRATION SUPPRESSION BY PIEZOELECTRIC ACTUATORS

JUNJIRO ONODA, TOSHIO TOMIZAWA, ATSUSHI NAKADA (Institute of Space and Astronautical Science, Sagami-hara, Japan), TAKAO ENDO, and HIDEHIKO TAMAOKI (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 635-640. refs

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Two types of approaches for active or semiactive vibration suppression of space truss structures, including a newly proposed one, are experimentally studied. One approach is to use the internal force generated by the elongation/contraction action of variable-length truss member which is composed of piezoelectric actuators. The other new approach is to use the dry frictional force where the normal force is controlled by piezoelectric actuators. The experiments demonstrate the effectiveness of both approaches. Author

A92-53569

EXPERIMENTAL SIMULATION OF SPACECRAFT CHARGING MITIGATION BY PLASMA EJECTION

SHOJI KITAMURA and KATSUHIRO MIYAZAKI (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 857-862. refs

Copyright

Attention is given to experimental simulation of spacecraft charging and its active mitigation, which was conducted in order to demonstrate that plasma plume ejection is effective in mitigating spacecraft charging, particularly differential charging. Spacecraft charging was simulated by irradiating a plate with electron beams. The film on the plate was irradiated with electron beams, and it was charged almost uniformly over its surface. Via hollow cathode operations, the surface was neutralized completely for small beam current ranges. For beam current ranges, the charging voltage rose to almost the same as for no hollow cathode operations at the center of the film, but its profile showed voltage decreasing with distance from the center. This result demonstrated that plasma ejection is effective in mitigating differential charging even with an ion flow shortage in the ejected plasma. P.D.

A92-53572

RADIATIVE THERMAL RESISTANCE OF COMMUNICATIONS TRANSPONDERS FOR SPIN-STABILIZED GEOSTATIONARY COMMUNICATIONS SATELLITES

AKIO ISO (Space Communications Research Corp., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 879-884. refs

Copyright

This paper describes the radiative thermal resistance which can be used to determine the available heat-dissipation power density of communications transponders in spin-stabilized

geostationary communications satellites equipped either with an antenna or a platform-despun system. The lower limits of space and surface thermal resistances are derived. The space thermal resistance between the communications transponder panel and the thermal shield is low, in comparison to that between the other components. The surface thermal resistance of the transponder panel is equal to those of the thermal shield and solar panel, and is much smaller than that of the antenna support. As a result, a lower limit of the radiative thermal resistance can be derived, and can be applied in designing future satellites. Author

A92-53573

THERMAL DESIGN AND TDM TEST OF THE ETS-VI

T. YOSHINAKA, K. KANAMORI (NASDA, Tokyo, Japan), N. TAKENAKA, J. KAWASHIMA, Y. IDO, and Y. KURIYAMA (Toshiba Corp., Space Program Div., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 885-890.

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The Engineering Test Satellite-VI (ETS-VI) thermal design, thermal development model (TDM) test, and evaluation results are described. The allocation of the thermal control materials on the spacecraft is illustrated. The principal design approach is to minimize the interactions between the antenna tower module and the main body, and between the main body and the liquid apogee propulsion system by means of multilayer insulation blankets and low conductance graphite epoxy support structures. The TDM test shows that the thermal control subsystem is capable of maintaining the on-board components within specified temperature limits. The heat pipe network is confirmed to operate properly, and a uniform panel temperature distribution is accomplished. The thermal analytical model is experimentally verified. The validity of the thermal control subsystem design is confirmed by the modified on-orbit analytical model. P.D.

A92-53576

DESIGN OF THERMAL CONTROL SYSTEM OF EFFU

SUECHIKA MASUDA, HIROSHI YAMAGUCHI (NASDA, Tokyo, Japan), KEIZO NAKAO, and SHIGEKI SUZUKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 903-908. refs

Copyright

The thermal design, the thermal analysis, and the test plan, including the thermal development model test, of the exposed facility flyer unit (EFFU) are described. EFFU is the exposed mission equipment installed on space flyer units (SFUs) and is thermally controlled independently of SFUs. The EFFU thermal control system is composed of the fluid loop system, the active thermal control system (ATCS), and the passive thermal control system (PTCS). The fluid loop system is the single phase loop, similar to the Japanese Experiment Module. Analysis results show that the equipment temperature is maintained within the allowable range by the ATCS and PTCS in the nonoperational mode. The fluid loop system dissipates the maximum internal heat, and supplies the equipment with the fluid in the required temperature range. P.D.

A92-53605

AN ELECTRIC SHOCK ABSORBING SYSTEM FOR THE DOCKING MECHANISMS IN SPACE

S. NIWA, M. SUZUKI, and K. KIMURA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1105-1112. refs

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A study of attenuation and shock absorbing characteristics of the docking system in space is presented. A laboratory prototype of an electromechanical shock absorbing system is developed to perform an experimental study on the docking system. The

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prototype developed uses a sonar ranging system as a substitute for the laser range sensor and is controlled by a microprocessor.
R.E.P.

A92-53607

A NEW DESIGN OF OPTIMAL CONTROLLERS FOR NONLINEAR SYSTEMS AND ITS APPLICATION TO SATELLITE ATTITUDE CONTROL SYSTEMS

TERUAKI HANAOKA (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1117-1124. refs
Copyright

A new design method of nonlinear control systems in the time-domain using previously developed iterative dynamic programming algorithm is proposed. This method provides a straightforward design technique for various nonlinear plants containing nonlinear elements in actuators of plants or plants themselves under the forms of optimal control policies of the minimum-time and minimum-fuel-consumption and more general performance criterion functions. This algorithm does not need a trial-and-error procedure. The controller of tabular forms obtained by this method was satisfactorily implemented in various simulations of attitude control systems including multiple-input multiple-output systems. All the controllers designed were tested in the on-line use with the analog simulation of the plants considered. The results obtained show that this technique is very effective in the design methods of nonlinear control systems. Author

A92-53612

A ROBUST ADAPTIVE ATTITUDE CONTROL FOR A LARGE SPACE STRUCTURE WITH NON-COLOCATED ACTUATORS AND SENSORS

YUZO SHIMADA (Nihon University, Funabashi, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1151-1158. Research supported by Nihon University. refs
Copyright

A 'design method for a model reference adaptive control' (DMMRAC) for the slewing control of a flexible space structure is presented. A rigid spacecraft with flexible appendages in which a smaller number of actuators than sensors have been installed is considered. To apply the DMMRAC theory to this spacecraft, sensors' signals are combined to make a p-input/p-output system. R.E.P.

A92-53613

APPLICATION OF TIME DOMAIN AND FREQUENCY DOMAIN CONTROL DESIGN METHOD FOR FLEXIBLE STRUCTURE SYSTEM

MASAYUKI SUZUKI (Nagoya University, Japan) and SHIGERU AOKI (Shimizu Corp., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1159-1164. refs
Copyright

Design methods are applied in the time domain and the frequency domain to flexible structure systems. Each technique is simulated and robustness and performance are compared based on the results. It is shown that the singular perturbation technique and H-infinity optimal control are regarded as an existing time domain design method and as a frequency domain design method, respectively. R.E.P.

A92-53614

ANTENNA POINTING SYSTEM ON FLEXIBLE SPACE STRUCTURES

TAKASHI KIDA, ISAO YAMAGUCHI (National Aerospace Laboratory, Chofu, Japan), SEIYA UENO (Yokohama National University, Japan), MASAKI TANAKA, and KEIICHI HIRAKO (Toshiba Corp., Komukai Works, Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th,

Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1165-1170.
Copyright

The dynamic interaction between the Antenna Pointing System and the structural vibration of large space structures is studied experimentally. The role of the damping improvement of the structure is discussed and demonstrated. All of the experimental results are verified by numerical evaluation. R.E.P.

A92-53615

EXPERIMENT ON WAVE-ABSORBING CONTROL FOR FLEXIBLE SPACE STRUCTURES

HIRONORI FUJII, KEN MIYACHI, TOSHIYUKI OHTSUKA, and SEI-ICHI ANAZAWA (Tokyo Metropolitan Institute of Technology, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1171-1176. refs
Copyright

Wave-absorbing control for vibration suppression of flexible space structures is demonstrated experimentally. The experimental model is a hinged-free flexible beam with a sensor and non-colocated torque actuator. The wave-absorbing control employs partial differential equations as the mathematical model of structural dynamics, and the controller can be designed without any use of the modal expansion. The control, thus, is free from the crucial truncation effect. The structural vibration is expressed in terms of propagating disturbances in the frequency domain. The control forces are applied to eliminate outgoing waves at the boundaries of the structure. Experimental results show satisfactory performance of the controller and good agreement with the performance predicted analytically. Author

A92-53616

DEPLOYMENT AND STATION KEEPING OF THE TETHERED MICROGRAVITY LABORATORY IN THE PROXIMITY OF THE LARGE MOTHER SPACESHIP

SHOICHI YOSHIMURA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1183-1188. refs
Copyright

Numerical simulations are conducted to study the use of a small tethered satellite for microgravity experiments in conjunction with a large spaceship such as a space station. The analysis is constrained by a target microgravity level and by a maximum tether length, and the system dynamics are described for deployment and deployment/stationkeeping. Specific attention is given to the possibility of tether tension control, microgravity levels of about 0.0001-0.00001 G, and tethers of less than 250 m. A complete absence of tension in the tether can be achieved by applying negative tether length rate after the tether reaches a nominal deployment length. This is followed by the stationkeeping phase in which the tether length is varied slightly with some damping. The present simulation shows that the required microgravity levels are theoretically achievable. C.C.S.

A92-53649

PRELIMINARY TEST RESULTS ON THE BERTHING AND DOCKING MECHANISMS FOR FUTURE SPACE INFRASTRUCTURES

EIICHI ENDO, HIDEHIKO MITSUMA (NASDA, Tsukuba Space Center, Japan), YASUAKI TANIGUCHI, KENJI OGIMOTO, and YASUHIRO TAKESHITA (Kawasaki Heavy Industries, Ltd., Space Systems Dept., Kakamigahara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1433-1438.
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A development status evaluation is presented for the autonomous berthing and docking system that is envisioned for Japanese orbital infrastructure operations, giving attention to the results of component-level tests; these encompass a berthing probe, structural latches, and an umbilical connection device.

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Whole-system tests were also conducted on a 2D air-bearing testbed. Attention is given to the detailed design features of the docking/berthing mechanism and to the performance criteria which these designs must meet. O.C.

A92-53653

DEVELOPMENT OF ON-ORBIT TEST EQUIPMENT OF JEM EXPOSED FACILITY USING A FREE FLYER

FUMIO OTUKI, NORIAKI ISHIHARA (NASDA, Tokyo, Japan), MIKIO MORIOKA, TOSHIO KATOH, and RAITA AMAGATA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1459-1464. refs
Copyright

NASDA's Space Flyer Unit, which is to be launched by an H II vehicle in 1994, will carry an Exposed Facility which will allow technological proofs of concept to be conducted for a similar component of the Japanese Experimental Module. The proof of concept efforts of the Exposed Facility will encompass a fluid-loop thermal control system, an equipment-exchange unit, and a gas dynamics experiment facility. A Structural Development Model of the Space Flyer will be subjected to static and mass properties tests in preparation for the initial deployment. O.C.

A92-53656

DEVELOPMENT STATUS OF ETS-VI

S. TANAKA, T. KATAGI, H. KITAHARA (NASDA, Tokyo, Japan), Y. YAMAMOTO, T. ITAKURA, K. ITO, and M. SUENAGA (Toshiba Corp., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1477-1488. refs
Copyright

Japan's Engineering Test Satellite (ETS) VI has been devised to probe the basic technology required for future operational communications and broadcasting satellites in the 1990s. An account is presently given of major design features, enabling technologies, and the current development status of ETS-VI, with a view to the extension of payload capabilities in future applications through the adoption of Ni-H₂ batteries, an ion-propulsion system, and lighter solar-array substrates with higher conversion-efficiency cells. O.C.

A92-53657

STRUCTURE DEVELOPMENT MODELS OF ETS-VI

TSUGUHIKO KATAGI, AKIO TSUJIHATA (NASDA, Tokyo, Japan), MASANOBU NISHIO, FUMIHIRO KUWAO, TAKASHI TSUKASHIMA, TATSUO KATOH, and TADAYOSHI AKAEDA (Toshiba Corp., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1489-1496. refs
Copyright

Japan's Engineering Test Satellite (ETS) VI has been designed to conduct several communications experiments relevant to future direct-broadcasting satellites and is currently in its design finalization phase. Two structure-development models have accordingly been devised for static and dynamic loading tests, respectively. Results are presented from the ETS VI development models' modal survey, acoustics, sinusoid vibration, pyrotechnic shock, alignment, and mass properties tests. O.C.

A92-53664

OVERVIEW OF THE JEM EXPOSED FACILITY

HIDEKAZU HASHIMOTO, KAZUHIKO KAMESAKI (NASDA, Tokyo, Japan), UICHI IMACHI, KAZUHIRO AIZAWA, YOSHIRO KONDO, MICHIO HORIE, and MINORU MIZUNO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1541-1546.
Copyright

Space Station Freedom's Japanese Experiment Module (JEM) system requirements have been refined over the course of its phase B preliminary design study. Attention is presently given to system requirements for the JEM Exposed Facility (EF) and the characteristics of its baseline configuration. The EF's subsystems are directly exposed to the space environment, and will be concerned with earth observations, communications, materials processing, etc. Attention is here given to the EF's power systems, command/control, thermal control, and user support capabilities. O.C.

A92-53668

CONCEPTUAL DESIGN OF JAPANESE MANNED SPACE PLATFORM

TSUTOMU IWATA, KAZUMI OKUDA (NASDA, Tsukuba Space Center, Japan), SHOICHI HOSHINA, RUSUKE ABE (Hitachi, Ltd., Space Technology and Systems Dept., Japan), and TAKASHI NAKAJIMA (Hitachi, Ltd., Space Systems Div., Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1565-1570.
Copyright

The Japanese Manned Space Platform (MSP) is envisioned as a stepping-stone to the National Space Station. An account is presently given of the configurational and functional concepts, assembly procedures, and technology-development requirements associated with the MSP. Major development initiatives are associated with the MSP's ecologically closed life support system, EVA, crew evacuation vehicle, and robotics. O.C.

A92-53690

A STUDY ON TECHNOLOGY OF A LARGE DEPLOYABLE ANTENNA FOR A MOBILE COMMUNICATIONS SATELLITE

TERUAKI OIKASA, SHIN-ICHI SATO, AKIO ISO, and TOSHIO SUGIMOTO (Space Communications Research Corp., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1715-1720. refs
Copyright

An account is given of the tradeoffs and key technologies of large deployable reflector antennas, as well as of their performance evaluation in light of their effective mass. A mesh-and-truss-type reflector deployable system is devised, and its performance is evaluated in view of an electrical scale model; measured radiation characteristics are determined and compared with calculated results. The cross-polarization level is very low, and dual-polarization-based frequency reuse may be implemented. O.C.

A92-53691

ELECTRICAL DESIGN AND CHARACTERISTICS OF THE MULTIBEAM ANTENNA SYSTEM FOR THE ETS-VI SATELLITE

AKIRA KONDO, TAKAO ITANAMI, KENJI UENO, and HIROYUKI KUMAZAWA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1721-1724. refs
Copyright

An account is given of the electrical design, evaluation method, and performance characteristics of Japan's Engineering Test Satellite VI. Attention is given to the antenna system and its radiation patterns in the 20 and 30 GHz bands; in view of manufacturing errors, alignment errors, and gravitational effects, good agreement is obtained between measured and calculated results. The same frequency is shown to be usable in alternate beams, and that dual polarization can be used on the same beam. O.C.

A92-53773

A CASE STUDY OF A MANNED SERVICE PLATFORM

TSUTOMU IWATA (NASDA, Tsukuba, Japan) and HIROYUKI TORII (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: International

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Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2267-2270. refs
Copyright

A Japanese manned service platform is being planned to serve other orbiting spacecraft with a 3-person crew, after 2005; this platform will serve as a space station prototype vehicle. An evaluation is presently made of the manned service platform's servicing requirements, capabilities, structural configuration and fabrication, and crew safety considerations. A five-module configuration is considered which encompasses habitat, service, control, resource, and logistics modules. O.C.

A92-55097

DEVELOPMENT OF SIMULATION CODE FOR RANDOM VIBRATIONS OF SPACECRAFT FUEL TANKS

TAKASHI MOCHIO, HAJIME KAWANO, TADAHICO HARA (Mitsubishi Heavy Industries, Ltd., Nagasaki Research and Development Center, Japan), MORIHIRO HAYASHIDA (Mitsubishi Heavy Industries, Ltd., Systems Engineering Dept., Tokyo, Japan), and KATSUMI FURUKAWA (Mitsubishi Heavy Industries, Ltd., Nagasaki Shipyard & Machinery Works, Japan) Mitsubishi Heavy Industries Technical Review (ISSN 0026-6817), vol. 29, no. 2, June 1992, p. 103-107. refs
Copyright

A new computer code to simulate structural response owing to random excitation has been developed to efficiently design the fuel tanks for spacecrafts against vibrations. This code, named CANDY, will be able to deal with random response and also fatigue failure estimation for three-dimensional geometrical structures with liquid. CANDY code has especially an additional function in which it is able to estimate some probabilistic characteristics of random response by the Monte Carlo method. This simulation code is verified by showing a comparison with analytical and experimental results. Author

A92-55307#

ON THE MOMENTUM TRANSFER MANEUVER FOR INITIAL ACQUISITION USING MULTI-WHEELS - ITS ANALYSIS AND APPLICATION

SONG J. DONG, JUN'ICHIRO KAWAGUCHI, HIROKI MATSUO, KEIKEN NINOMIYA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and KEN MAEDA (NEC Aerospace Co., Yokohama, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 3. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 1583-1589. refs
(AIAA PAPER 92-4332) Copyright

This paper proposes a control law that stabilizes momentum transfer maneuver using multiwheels. The law is proved analytically via Liapunov's direct method. As another consequence, this paper point out equilibrium 'singular states' which closed momentum transfer control may fall into, and from which any evasive path cannot be found. Sufficient conditions are provided so that such singular states can be circumvented by an appropriate control law proposed. It is revealed that six singular points including trivial target state exist in general. It is also shown that appropriate choice of a control law reduces the number of 'singular states'. As a practical application, numerical examples are shown which are related to the scientific X-ray telescope satellite ASTRO-D, to be launched in February, 1993. Author

A92-55739

ANALYSIS OF NONLINEAR VIBRATION OF SPACE APPARATUS CONNECTED WITH PIN-JOINTS

Y. HAYASAKA, N. OKAMOTO, T. HATTORI, T. KANAKUBO, H. KOMINE (Hitachi, Ltd., Tokyo, Japan), J. ONODA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and H. ITO (Institute for Unmanned Space Experiment Free Flyer, Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p. Research supported by New Energy and Industrial Technology Development Organization

of Japan. refs

(IAF PAPER 92-0315) Copyright

The paper discusses nonlinear vibration of space apparatuses connected with pin-joints. In particular, superharmonic vibration due to a clearance of pin-joints are investigated by numerical simulations with a simple kinetic system and vibration experiments of the isothermal heating furnace which will be installed on the Space Flyer Unit. As the results of simulations and experiments superharmonic resonance was observed which depends on the forcing amplitude and the order of superharmonic resonance. A reliability estimation which takes superharmonic resonance into consideration is also presented. Author

A92-55752

SPACECRAFT SHIELDING VERIFICATION AT IMPACT VELOCITY OVER 10 KM/SEC

K. OGASAWARA, M. TOYAMA, A. KUNOH (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan), M. HIKIJI, and H. MIYOSHI (Chugoku Kayaku Co., Ltd., Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 7 p. refs
(IAF PAPER 92-0333) Copyright

This paper presents the meteoroid/debris shields verification plan at over 10 km/sec impact velocity which has been unable to be attained by the conventional hypervelocity impact test facility using two-stage light gas guns. Due to the increase of the orbital debris nowadays, spacecraft have to be equipped with the hypervelocity impact shields to meet survivability requirements from the impacts. Such shields should be verified on their protection performance over 10 km/sec because the impact velocity can reach up to 15-16 km/sec on the LEO. The key to presented verification plan is to use the newly developed hypervelocity launcher using the inhibited conical-shaped charge. This launcher is able to generate a hypervelocity projectile whose velocity is 10.5 km/sec and weight is around 0.3 gm. Preliminary shots by this launcher generated hypervelocity impact craters which are in good agreement with the estimated damage by the energy relation derived from former research. Author

A92-55796

ALIGNMENT METHOD FOR LARGE ETS-VI ON-BOARD ANTENNAS

Y. KAWAKAMI, I. OHTOMO, and T. ITANAMI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. refs
(IAF PAPER 92-0419) Copyright

The paper discusses an accurate alignment method applied to a large on-board antenna. Modern satellite communication systems require on-board antennas to be larger in size and the beam pointing must be more accurate. This makes it difficult to integrate and test the antenna systems on the ground, because of gravity deformation. A method that confirms both accurate 3D alignment on the ground and estimated in-orbit antenna performance is proposed. This method is applied to the ETS-VI antenna system which consists of 3.5-m and 2.5-m antennas whose pointing accuracy must be within 0.015 deg. Alignment measuring tools used in the method, alignment procedures in the antenna electrical test and the antenna integration, and alignment measurement results of the ETS-VI antenna system are presented. Author

A92-55883

A CONCEPT STUDY OF INEXPENSIVE SOLAR POWER SATELLITE USING CENTRIFUGAL FORCE FOR SELF-DEPLOYMENT

Y. KURODA, S. MATSUMOTO, T. SAITO, K. NOZAKI, H. TADOKORO, H. KANAMORI, and K. TAKAGI (Shimizu Corp., Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 5 p. refs
(IAF PAPER 92-0596) Copyright

The paper examines a concept of inexpensive solar power satellites that has the following characteristics: deployable structure, utilization of centrifugal force, no EVA and no construction

robots, and attitude control by natural forces such as the solar wind or the magnetic field. Taking into account these characteristics, no less than ten concepts are generated. Each idea is then evaluated according to such criteria as construction, material, and maintenance costs, and ease of attitude control.

L.M.

A92-57121

JAPANESE EXPERIMENT MODULE EXPOSED FACILITY (JEM-EF) OVERVIEW

YOSHIRO KONDO, MICHIO HORIE (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and MICHIO TAKAHASHI (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 13 p. refs (IAF PAPER 92-0690) Copyright

The requirements and constraints for the JEM-EF payloads are described, with emphasis on resources, envelope, and interfaces, including structural, mechanical, thermal, and EF systems. The preliminary design review of the JEM-EF system has been completed, and manufacturing, assembly, and tests of the Engineering Model of the JEM-EF are under way, with the critical design review scheduled for 1994. It is expected that the preliminary design of the JEM-EF payloads will begin soon. L.M.

A92-57145

END-TO-END VERIFICATION OF JEM OPERATIONS

HIDESHI KOZAWA, KATSUO YONEZAWA, TOSHIRO SAKAGUCHI (NASDA, Tokyo, Japan), and MASAKI TANAKA (Toshiba Corp., Kawasaki, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. refs (IAF PAPER 92-0717) Copyright

Methods of evaluating and verifying JEM operability at each milestone of JEM operations system development are described. JEM operability is to be assessed in the early phase of system design, and the results are to be reflected in the development activities in the more detailed design phase. JEM operability is to be verified by reviewing the design documents in the early phase of system development. End-to-end verification of JEM operability is also planned. The JEM flight demonstration (JFD) project and the JEM remote manipulator system small fine arm are to be tested by replacing JEM orbital replacement units on the Shuttle Orbiter. The JFD mission is also reported. P.D.

N92-17101*# National Space Development Agency, Tokyo (Japan).

STATUS OF JAPANESE EXPERIMENT MODULE (JEM) ACTIVITIES

In NASA, Washington, Beyond the Baseline 1991: Proceedings of the Space Station Evolution Symposium. Volume 1: Space Station Freedom, Part 1 p 39-57 Sep. 1991

Avail: CASI HC A03/MF A03

The current status of the JEM activities are presented in graphic form. The JEM spacecraft configuration is presented. The JEM configuration consist of the Pressurized Module, the Exposed Facility, the Experiment Logistics Module which consist of a pressurized section and an exposed section; and the Remote Manipulator System. The master schedule of the space station is given. Also the development tests of the structure and mechanism, the electrical power system, the data management system, the thermal control system, the environment control system, the experiment support system, and the remote manipulator system are listed. E.R.

N92-17754# National Aerospace Lab., Tokyo (Japan). Aerodynamics Div.

WEIGHT EVALUATION AND SENSITIVITY ANALYSIS FOR SPACE PLANE. PART 2: TSTO Report No. 1 [UCHU OHKANKI NO JURYO HYOKA TO KANDO KAISEKI (SONO 2): TSTO] MASAO SHIROUZU Feb. 1989 19 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-602-PT-2; JTN-92-80241) Avail: CASI HC A03/MF A01

Reported here is the weight evaluation and sensitivity analysis of a two stage to orbit (TSTO) type spaceplane. The major purpose

of this analysis is to get the basic data which is necessary to determine the configuration of the spaceplane. Those data are used in wind tunnel tests. As the result of weight evaluation, it is confirmed that the TSTO is more feasible than single stage to orbit (SSTO). The further analysis leads to the basic specification of TSTO as follows: total weight is 350 tons; the booster wing area is 583 square meters; and the orbiter length is 39.5 meters. As for sensitivity analysis, the following parameters are checked: orbiter lift-off weight, orbiter separation condition, lift-off wing load, and cruising range. As the result of sensitivity analysis, it is confirmed that the orbiter velocity on separation and the engines which can be used in high Mach number condition are the important factors which enable the TSTO type spaceplane.

Author (NASDA)

N92-18241# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

DAMPING ENHANCEMENT OF LARGE SPACE STRUCTURES BY PROOF-MASS-ACTUATORS

TAKASHI KIDA (Yokohama National Univ. (Japan).), ISAO YAMAGUCHI (Yokohama National Univ. (Japan).), SEIYA UENO (Yokohama National Univ. (Japan).), and MASAKI TANAKA (Toshiba Corp., Tokyo, Japan) May 1991 23 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1114) Avail: CASI HC A03/MF A01

The enhancement of modal damping is a key technology in Large Space Structures (LSS) robust control. A controller design is examined which actively augments substantial damping factors to LSS. The stability analysis of the closed loop system is discussed, and was subsequently confirmed by a ground based control experiment which used a newly developed pivoted type Proof Mass Actuator (PMA). The controller uses a direct velocity feedback control. A multi-input multi-output control system was examined using two PMAs, in addition to the single-input single-output case. In both cases, the experimental results showed excellent vibration suppression capability. A sizing problem of the PMAs is also discussed.

Author

N92-22093# National Space Development Agency, Tokyo (Japan). Engineering Test Satellite Group.

DEVELOPMENT TEST RESULTS OF ETS-6 STRUCTURAL DEVELOPMENT MODEL

AKIO TSUJIIHATA In its Preprints of NASDA's 5th Technical Symposium p 91-122 1 Jun. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

The Engineering Test Satellite-6 (ETS-6) is a two-ton-class three-axis-stabilized geostationary spacecraft and was developed to be launched in Summer 1993 by the H-2 Launch Vehicle. For the ETS-6 structural development, full-scale structural development models were fabricated in accordance with the basic design results and tests were performed. Those are Structural Development Model-Static (SDM-S) and Structural Development Model-Dynamic (SDM-D). The objective of the SDM-S is to verify the strength of structure and the SDM-D is to verify the evaluation of mechanical environments. This paper presents a summary of the ETS-6 SDM and the results of the development test. The results of the development test provided useful test data to evaluate the design, the manufacture, and the test procedure for the protoflight model.

Author (NASDA)

N92-22094# National Space Development Agency, Tokyo (Japan). Tsukuba Space Center.

RESEARCH AND DEVELOPMENT ON LARGE DEPLOYABLE ANTENNA

YASUMASA HISADA In its Preprints of NASDA's 5th Technical Symposium p 123-157 1 Jun. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

This paper describes the ground deployment test of a synthetic aperture radar (SAR) antenna and a five meter diameter petal deployable antenna under research and development by the

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National Space Development Agency of Japan (NASDA). The SAR antenna will be mounted on Earth Resources Satellite-1 (ERS-1) and the five meter diameter petal deployment antenna will be mounted on a Tracking and Data Relay (TDRS) Satellite. This paper especially describes the policy on research and development of a large deployable antenna in NASDA, and the ground deployment test results of these two antennas are also introduced.

Author (NASDA)

N92-23781# National Space Development Agency, Tokyo (Japan).

DEVELOPMENT OF JAPANESE EXPERIMENT MODULE

FUMIO OTSUKI, KAZUHIKO KAMESAKI, KUNIAKI SHIRAKI, and KAZUYUKI TASAKI / In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 3-8 Oct. 1991

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The National Space Development Agency of Japan (NASDA) started preliminary design of the JEM (Japanese Experiment Module) in Jan. 1990 along with the component development test activities, and has a plan to conduct the preliminary design review in early 1992. NASDA's JEM program faces many challenges as it strives to overcome the large number of technical obstacles associated with designing, developing and integrating the JEM. An overall picture of the JEM program structural development activities including design, testing and analysis activities, is presented with focus on some technical challenges which have been or must be surmounted in order to assure JEM structural safety. Some approaches taken to implement these solutions are introduced.

ESA

N92-23820# National Space Development Agency, Ibaraki (Japan).

CONCEPTIONAL DESIGN TO HEAT-RESISTANT AIRFRAME OF HOPE

MASATAKA YAMAMOTO / In ESA, Spacecraft Structures and Mechanical Testing, Volume 1 p 277-282 Oct. 1991

Copyright Avail: CASI HC A02/MF A04

The HOPE (Japanese Spaceplane) airframe is recognized to meet with severe thermal and mechanical environment through the operation phases such as launch, reentry, and landing. The conceptional design model is studied using the results of research and development of heat resistance materials and of heat resistance structural design. The structural configuration of heat resistance is to fit the thermal protection panels out of the frame structure, in addition to mounting the onboard thermal insulation material. Primary structural materials are carbon fiber reinforced polyimide (up to 300 C) and carbon-carbon (up to 1700 C); thermal protection materials are ceramic tile, titanium alloy panel, and carbon-carbon panel.

ESA

N92-24439# National Space Development Agency, Ibaraki (Japan).

GUIDANCE, NAVIGATION, AND CONTROL STRATEGY IN A PROXIMITY RANGE FOR AUTONOMOUS RVD MISSION

YASUFUMI WAKABAYASHI (National Space Development Agency, Tokyo (Japan).), ISAO KAWANO (National Space Development Agency, Tokyo (Japan).), HIROYUKI SUZUKI (National Space Development Agency, Tokyo (Japan).), NORIMASA YOSHIDA (Mitsubishi Electric Corp., Kamakura (Japan).), HIROAKI MIYAZAKI (Mitsubishi Electric Corp., Kamakura (Japan).), and TATSUSHI KANBE (Mitsubishi Electric Corp., Kamakura, Japan) / In ESA, Spacecraft Guidance, Navigation and Control Systems p 55-60 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

Study results on autonomous rendezvous and docking (RVD) for unmanned spacecraft, intended for the first Japanese RVD system and the associated basic ideas on the Guidance, Navigation and Control (GNC) System in the relative/final approach and docking phase are outlined. Special emphasis is put on those aspects such as safety, standardized operation, and hierarchical and modular design of both Flight Management System (FMS) and Flight Control System (FCS). Some of the ideas, including a simultaneous standardization of flight path and operational modes,

hierarchical control of GNC functions, and a simplified formulation of relative GPS (Global Positioning System) navigation filter, are discussed. Remarks on the present status of the study are included.

ESA

N92-24442# Ministry of International Trade and Industry, Tokyo (Japan). Electrotechnical Lab.

CONTROL OF FREE FLYING SPACE ROBOT FOR CAPTURING MANEUVER

KAZUO MACHIDA (European Space Research Lab., Noordwijk (Netherlands).), YOSHITSUGU TODA (European Space Research Lab., Noordwijk (Netherlands).), TOSHIKI IWATA (European Space Research Lab., Noordwijk (Netherlands).), NOBUYUKI KUBOTA (European Space Research Lab., Noordwijk (Netherlands).), KIYOSHI IOI (Kawasaki Heavy Industries Ltd., Akashi (Japan).), TAKASHI KATSURAGAWA (Kawasaki Heavy Industries Ltd., Akashi (Japan).), NOBUYOSHI MUROI (Kawasaki Heavy Industries Ltd., Akashi (Japan).), and KENJI OGIMOTO (Kawasaki Heavy Industries Ltd., Kakamigahara, Japan) / In ESA, Spacecraft Guidance, Navigation and Control Systems p 73-78 Dec. 1991

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A series of maneuvers for satellite capturing task are addressed to study the control strategy of a free flying space robot with dual arm. The first maneuver of the robot is to approach a target. The resolved motion rate control method using the generalized Jacobian matrix has been suggested for arm slue of a base free space robot. A control method using inertial sensor feedback for arm slue instead of using a generalized Jacobian to reduce the computational load and to increase robustness, is proposed. The second maneuver is to capture a moving target. The simulation technique which represents the contact and grasping process including momentum exchange, is developed. The arm control method for soft catching, using impedance control, is studied. These control maneuvers are investigated by using a body referenced dynamic model of a planar dual arm flying robot with joint flexibility.

ESA

N92-24452# National Space Development Agency, Ibaraki (Japan).

THE ORBITAL RE-ENTRY EXPERIMENT VEHICLE, AND THE FLIGHT EXPERIMENT OF GPS NAVIGATION FOR HOPE

T. IZUMI (Tsukuba Space Center, Ibaragi (Japan).), I. KAWANO (Tsukuba Space Center, Ibaragi (Japan).), Y. TAKIZAWA (Tsukuba Space Center, Ibaragi (Japan).), K. MASUDA (Mitsubishi Heavy Industries Ltd., Hiroshima (Japan).), T. MORI (Mitsubishi Heavy Industries Ltd., Hiroshima (Japan).), and K. KITO (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) / In ESA, Spacecraft Guidance, Navigation and Control Systems p 145-150 Dec. 1991

Copyright Avail: CASI HC A02/MF A06

The Japanese H2 Orbiting Plane (HOPE) is an unmanned winged space vehicle which is planned to be launched in the end of 1990s. The Orbital Reentry Experiment (OREX) for acquiring engineering data for HOPE is presented. The experiment is planned to be carried out in early 1993. The vehicle is inserted into low Earth orbit by H2 rocket test flight. After about one revolution, it will deorbit and reenter the atmosphere. Global Positioning System Receiver (GPSR) is the key component for the navigation system of HOPE. A five-channel experimental GPSR model is installed in OREX as mission equipment, and the engineering data are obtained for the design of the HOPE's GPSR. The OREX mission, vehicle system, and guidance and control system are addressed. HOPE navigation system and the GPS experiment plans on OREX are presented.

ESA

N92-24463# Mitsubishi Electric Corp., Hyogo (Japan).

AUTONOMOUS CAPTURE EXPERIMENT OF FREE-FLYING TARGET ON THE GROUND SIMULATOR

H. SHIMOJI (Mitsubishi Electric Corp., Amagasaki (Japan).), M. INOUE (Mitsubishi Electric Corp., Amagasaki (Japan).), K. NINOMIYA (Tokyo Univ., Sagami-hara (Japan).), I. NAKATANI (Tokyo Univ., Sagami-hara (Japan).), and J. KAWAGUCHI (Tokyo

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Univ., Sagamihara, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 225-230 Dec. 1991
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In order to develop a free flying robot, a motion simulator is developed in which a 0 G environment is simulated in real-time by combining a numerical simulation based on the law of momentum conservation and servomechanisms. On the simulator an experimental free flying robot is constructed which consists of two CCD (Charge Coupled Device) cameras and a manipulator. It is confirmed through experiments that this robot can automatically acquire the target state information using a Kalman filter for the images and directing the manipulator to capture the free flying target even, if the robot itself is freely flying. ESA

N92-24476# Nippon Electric Co. Ltd., Yokohama (Japan). Aerospace System Div.

TEST SYSTEM FOR FINE ATTITUDE CONTROL SYSTEMS OF ASTRONOMY SATELLITES

K. FUJIWARA (Nippon Electric Co. Ltd. (Japan).), T. KAWAHARA (Nippon Electric Co. Ltd. (Japan).), T. SAITOH (Nippon Electric Co. Ltd. (Japan).), and K. NINOMIYA (Tokyo Univ., Sagamihara, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 321-326 Dec. 1991
Copyright Avail: CASI HC A02/MF A06

A high energy solar physics satellite (Solar-A), an X ray astronomy satellite (Astro-D), and a space Very Long Base Interferometry (VLBI) satellite (Muses-B) are currently under development. Among the astronomy satellite series, especially high accuracy pointing control is required for the three satellites. The ACS (Attitude Control System) is important because it guarantees the performance and reliability of the ACS in orbit. This test requires the accurate and quick response dynamics simulator. The approach to the dynamics simulator using personal computers is described. The strategy of the ACS tests of the astronomy satellites, that effectively insures the performance and reliability, is presented. ESA

N92-24492# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

ATTITUDE AND ORBIT CONTROL SYSTEM OF THE VSOP MISSION SPACECRAFT MUSES-B

K. NINOMIYA (Tokyo Univ. (Japan).), T. HASHIMOTO (Tokyo Univ. (Japan).), T. KURII (Nippon Electric Co. Ltd. (Japan).), and N. OGURA (Nippon Electric Co. Ltd., Yokohama, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 461-465 Dec. 1991

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Muses B is a Japanese space VLBI (Very Long Baseline Interferometry) satellite to be launched in 1995 by the first flight of the Mu 5 launch vehicle now under development. The program is called VSOP (VLBI Space Observatory Program). Since only one ground station, at Uchinoura, Japan, is available for commanding the spacecraft, onboard automatic operation and fail-safe capability are strongly required. On the other hand, weight restriction does not allow much redundancy to be adopted. The Attitude and Orbit Control System (AOCS) is described with emphasis on how onboard automation and fail safe operations are achieved to a maximum extent without depending on redundant hardware. ESA

N92-24773# Tsukuba Space Center, Ibaragi (Japan). Tracking and Control Center.

SYNCHRONOUS OPERATION OF MOS-1 AND MOS-1B

T. YOSHIKAWA, M. MATSUURA, K. UENO, and M. KASHIMOTO *In* ESA, Spacecraft Flight Dynamics p 389-395 Dec. 1991
Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

A method for realizing Sun synchronous and recurrent orbits is explained. Two orbits realized by this method have various properties effective for Earth observation. This method is based on considering the local Sun time of the descending node, the deviation of the ground track from a world reference system and the difference between two ground tracks. Simple functions are

used in the analysis. The results obtained in applying this method to the synchronous operation of MOS-1 and MOS-1b (Marine Observation Satellites) are presented. ESA

N92-25373# National Space Development Agency, Tokyo (Japan). Space Station Group.

SPACE STATION PROGRAM AND PRELIMINARY DESIGN OF JEM

KUNIAKI SHIRAKI *In its* Preprints of NASDA's 6th Technical Symposium p 23-52 5 Jun. 1991 *In* JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A02

In January 1990, the National Space Development Agency of Japan (NASDA) started the preliminary design of JEM (Japanese Experiment Module) as an element of the international space station Freedom program, and also started development test activities. NASA was asked by the U.S. Congress to restructure the space station Freedom program as a condition of 1991 budget approval. Restructuring activities were completed. This report provides the results of space station Freedom program restructuring as well as the status of JEM preliminary design.

Author (NASDA)

N92-25374# National Space Development Agency, Ibaraki (Japan).

DESIGN OF ORBITAL RE-ENTRY EXPERIMENT VEHICLE AND OUTLINE OF THE EXPERIMENT

TOSHIO AKIMOTO, TOMOYUKI KOBAYASHI, MOTOYUKI INABA, TATSUSHI IZUMI, and ISAO KAWANO *In its* Preprints of NASDA's 6th Technical Symposium p 53-93 5 Jun. 1991 *In* JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A02

The National Space Development Agency of Japan (NASDA) plans an Orbital Re-entry Experiment (OREX) in the winter of 1993 as part of a study of the H-2 Orbiting Plane (HOPE). There are some critical technical subjects in developing HOPE. Especially, relating to atmospheric re-entry, critical items are estimating aerodynamic and aerodynamic heating characteristics of the vehicle in the hypersonic region, and developing heat-resistance materials and thermal protection systems. In order to acquire basic data about these items, OREX is planned. In this experiment, an experimental vehicle will be launched and inserted into orbit by the first flight of the H-2 Launch Vehicle, and re-enter into the atmosphere afterward. During atmospheric re-entry, data about aerodynamic heating, etc., will be acquired. Author (NASDA)

N92-25621# National Space Development Agency, Tokyo (Japan). Earth Observation Satellite Group.

DEVELOPMENT STATUS OF SPACE CRAFT

CHU ISHIDA *In its* International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 1-6 2 Nov. 1990 (EW-1) Avail: CASI HC A01/MF A02

Presented in viewgraph format, the status of JERS-1 (Japan Earth Resources Satellite-1) development is outlined. Topics addressed include: JERS-1 project organization; JERS-1 development schedule; design parameters such as orbit category, altitude, inclination, period, recurrent period, local mean time; on orbit configuration of JERS-1; and satellite components such as mission instrument system and satellite bus system e.g., Synthetic Aperture Radar (SAR), and Communications and Data Handling Subsystem (C&DH). Author (NASDA)

N92-25831# National Space Development Agency, Tokyo (Japan).

PRELIMINARY DESIGN OF JEM ECLSS AND TCS

T. SUZUKI (Tokyo Univ. (Japan).), F. OTSUKI (Tokyo Univ. (Japan).), K. SUZUKI (Mitsubishi Heavy Industries Ltd., Tokyo (Japan).), S. SHIBUTANI (Mitsubishi Heavy Industries Ltd., Tokyo (Japan).), A. HATTORI (Ishikawajima-Harima Heavy Industries Co. Ltd., Mizuho (Japan).), H. SASAYAMA (Ishikawajima-Harima Heavy Industries Co. Ltd., Mizuho (Japan).), M. INOUE (Ishikawajima-Harima Heavy Industries Co. Ltd., Mizuho (Japan).), and W. SUGAI (Ishikawajima-Harima Heavy Industries Co. Ltd.,

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Tokyo, Japan) In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 45-50 Dec. 1991
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Preliminary design of the Japanese Module (JEM), which will be attached to the U.S. Space Station Freedom (SSF), began in early 1991. The target of the design activities is the Preliminary Design Review (PDR) planned in the beginning of 1992. The pressurized module of the JEM is composed of several subsystems including the Environmental Control and Life Support System (ECLSS), the Thermal Control System (TCS), mechanical equipment (airlock), the data management system, the communications and tracking system, the electrical power system, and the experiment support system. The preliminary design of ECLSS and TCS including the baseline configurations and the design requirements are described. ESA

N92-25902# Tokyo Univ., Sagami-hara (Japan). Inst. of Space and Astronautical Science.

SIMULTANEOUS MEASUREMENT OF SOLAR ABSORPTANCE AND TOTAL HEMISPHERICAL EMITTANCE ON A SCIENTIFIC SATELLITE AKEBONO

A. OHNISHI (Chiba Inst. of Tech., Narashino (Japan).), Y. NAKAMURA (Chiba Inst. of Tech., Narashino (Japan).), Y. KAWADA (Chiba Inst. of Tech., Narashino (Japan).), and T. HAYASHI (Chiba Inst. of Tech., Narashino, Japan) In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 561-564 Dec. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Results of an onboard simultaneous measurement of solar absorptance (α_s) and total hemispherical emittance (ϵ_H) for several thermal control materials are reported. This measurement was carried out with the scientific satellite Akebono. The principle of this measurement is based on a calorimetric method utilizing solar radiation and electrical heat input through a heater attached to the sample. This technique allows simultaneous determination of α_s and ϵ_H by giving several different levels of input power to the sample heater, and for the data reduction, there is no need to use the values of parameters, such as the mass or the specific heat of the sample materials. Five kinds of test samples are located on the top plate of the spacecraft to face the Sun. The result obtained for α_s and ϵ_H by the present method in the early phase is compared to the preflight data. The degradations of α_s and ϵ_H in the orbit are evaluated as a function of equivalent Sun hours. ESA

N92-33754# National Space Development Agency, Ibaraki (Japan).

REVIEW ON MANNED SERVICE PLATFORM (MSPF) [YUJIN SABISU PURATTOFOMU (MSPF) NO KENTOU]

YUTAKA TAKANO In its Future Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

The Manned Service Platform (MSPF) is described. The MSPF is, in reality, a small space station and will be constructed in orbit. There are three reasons to construct MSPF's: (1) to establish on-orbit service bases for other spacecraft; (2) to conduct technology development and verification of manned space activities that are particular to Japan; and (3) to provide manned space experiment opportunities in the area of space environment utilization. Author (NASDA)

N92-33755# Mitsubishi Electric Corp., Kamakura (Japan).

ELEMENT TECHNOLOGIES FOR MANNED SERVICE PLATFORMS [YUJIN SABISU PURATTOFOMU NO YOUSO GIJUTSU]

MITSURU KOJIMA, HIROAKI OBARA, and KATSUTOSHI OOMURA In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

The space station, in low earth orbit (LEO), is preeminent in its ability to function as the nucleus of a space-based infrastructure.

The space station program is being promoted as a development center, and Japan is participating in the program by developing the Japanese Experiment Module (JEM). Due to limitations inherent in the space station's design, it is necessary to develop Japan's original manned platform. Problems are to be expected in the development of basic technologies for the Manned Service Platform (MSPF). Four of these basic technologies are investigated. The areas are as follows: (1) structure and mechanism technology; (2) attitude and orbit control technology; (3) automation and autonomy technology; and (4) manned support technology.

Author (NASDA)

N92-33756# Hitachi Ltd., Tokyo (Japan).

CONCEPTUAL DESIGN FOR MANNED SERVICE PLATFORMS [YUJIN SABISU PURATTOFOMU NO GAINEN SEKKEI]

SHOUICHI HOSHINA, RYUUSUKE ABE, and SHIGERU KIMURA In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 23 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

Conceptual designs of past manned service platforms (MSPF's) are summarized. Mission concepts and system architectures are evaluated by comparing them to reference examples. The largest design drivers are the infrastructure concepts and development of the integrated assembly sequences. First, the functions and properties to satisfy the users' requirements are reviewed in general, and then the characteristics of the MSPF (Manned Service Platform) project are analyzed. Reviews are conducted on their system concepts, assembly and construction, and their operations. Author (NASDA)

N92-33763# Mitsubishi Space Software Corp. (Japan).

ANALYSIS OF SPACECRAFT ENTRY INTO MARS ATMOSPHERE [KASEI TAIKI TOTSUNYUU KAISEKI]

KEN NAKAJIMA and KOUTAROU NAGANO In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 23 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

The effects on a spacecraft body while entering the Martian atmosphere and the resulting design constraints are analyzed. The analyses are conducted using the Viking entry phase restriction conditions and a Mars atmosphere model. Results from analysis conducted by the Program to Optimize Simulated Trajectories (POST) are described. Results obtained from the analysis are as follows: (1) flight times depend greatly on lift-to-drag ratio and less on ballistic coefficients; (2) terminal landing speeds depend greatly on ballistic coefficients and less on lift-to-drag ratios; (3) the dependence of the flight path angles on ballistic coefficients is slightly larger than their dependence on lift-to-drag ratios; (4) as the ballistic coefficients become smaller and the lift-to-drag ratios become larger, the deceleration at high altitude becomes larger; (5) small ballistic coefficients and low lift-to-drag ratios are required to meet the constraints of Mach number at parachute deployment and deployment altitude; and (6) heating rates at stagnation points are dependent on ballistic coefficients. It is presumed that the aerodynamic characteristics will be 0.2 for the lift-to-drag ratio and 75 kg/sq m for the ballistic coefficient for the case of a Mars landing using capsules similar to those used in the Viking program. Author (NASDA)

N92-33793# Fuji Heavy Industries Ltd., Tokyo (Japan).

REVIEW ON OPERATION CONCEPTS AND SEPARATION SIMULATION OF M-5 ROCKET VEHICLE AIR-LAUNCH PROGRAM [M-5 ROKETTO KUUCHUU HASSHA KEIKAKU NO UNYOU KOUSOU OYOBI RIDATSU SHIMYURESHON NO KENTOU]

TADASHI ISHIKAWA, HIDEHIRO HIROSE, YASUHIRO TANI, and YOUSUKE NAGAO In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE Prepared in cooperation with Tokyo Univ., Japan and Nissan Motor Co. Ltd., Tokyo, Japan

Avail: CASI HC A03/MF A10

This report reviews the methods to load and separate the M-5 air-launched rocket vehicle from the mother plane. Comparison of

the features, merits, demerits, and separation profiles of the M-5 air-launched rocket vehicle with those of the U.S. air-launched rocket vehicle 'Pegasus' are made. The feasibility of separation from the mother plane is verified by simulation. Author (NASDA)

N92-33796# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
FEASIBILITY OF MICROMINIATURE SATELLITES [CHOU KOGATA EISEI NO KANOU SEI NI TSUITE]
 RYUICHI IMAI *In its Future Space Activities Workshop: Lunar Base Workshop 1991* 20 p 17 Jul. 1991 In JAPANESE
 Avail: CASI HC A03/MF A10

A conceptual study is conducted on technical problems and system design techniques to accomplish higher performance microminiature satellites by smaller systems. Applications of microminiature satellite technology to practical satellite mission are mentioned. Concepts of microminiature satellites, measures to miniaturize satellites, and micro-miniaturization technologies for communication and data processing, electric solar power paddle, attitude and orbit control, structure, thermal control, propulsion, and instrumentation systems are outlined. Examples of miniaturizing satellite missions such as planet exploration, low-altitude communication networks, space positioning system, low-altitude earth observation mission, clustered satellites, tethered satellites, and timely observation are described. Satellite miniaturizing technology can also be used to launch systems by lasers, and superconductive linear catapults (space escalator). It is pointed out that keys to promote satellite miniaturization are electronics, precision machining, raw material, electric power source technologies, and system design technology to integrate those technologies. Author (NASDA)

N92-33797# Mitsubishi Electric Corp., Tokyo (Japan).
STUDY ON MINIATURIZATION OF SATELLITES [EISEI KOGATA KA NO KENTOU]
 HIROAKI OBARA, KATSUTOSHI OOMURA, and OSAMU SAITOU *In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991* 21 p 17 Jul. 1991 In JAPANESE
 Avail: CASI HC A03/MF A10

Problems in designing miniaturized satellite systems consisting of miniaturized constituent elements and missions suitable to miniaturized satellites, and subjects of technical development available for miniaturization are examined and reviewed. Results of reviews on satellite miniaturization of the following subsystems are outlined: (1) communication and data processing subsystem; (2) electric power supply; (3) sensors (optical and inertial sensors, and GPS (Global Positioning System) receivers) and actuators (wheels, RCSs (Reaction Control Subsystem)); and (4) structure and thermal control subsystem. Problems in designing the system are: (1) introduction of commercialized goods technology; (2) anti-space environment measures; (3) user friendly operation system; and (4) disposal of used satellites. Miniaturized satellite utilization missions considered are: (1) technology development mission (scientific and engineering experiments); (2) communication and positioning mission; (3) observation mission; and (4) planet exploration mission. Author (NASDA)

N92-33855# Science and Technology Agency, Tokyo (Japan). Office of Space Utilization.
BASIC LINE OF SPACE STATION UTILIZATION
 JUNJI YOSHIHARA *In its The 14th Space Station Utilization Workshop in Japan* p 13-29 21 Jan. 1992 In JAPANESE
 Avail: CASI HC A03/MF A02

The basic experiments that will require the use of the Japanese Experiment Module (JEM), as a component of the NASA space station, are discussed. The following topics are addressed: outlines of the space station program; schematic drawings of the space station (at the Permanently Manned Capability (PMC)) and the JEM; JEM project promotion system; present status of the JEM project; preparation status of JEM operation and utilization; characteristics of the space station program; terms of utilization; JEM utilization plan preparation schedule; selection of experiment

themes and common experiment equipment; and measures to promote JEM utilization. Author (NASDA)

N92-33858# National Space Development Agency, Tokyo (Japan). Space Experiment Group.
PREPARATION FOR UTILIZING JEM
 TADAOKI MOCHIDA *In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan* p 81-116 21 Jan. 1992 In JAPANESE
 Avail: CASI HC A03/MF A02

A description of the status of the space environment utilization promotion project for the Japanese Experiment Module (JEM) is provided in viewgraph format. The following topics are addressed: development of user accommodations, support systems, experiment design, experiment equipment, and common experiment technologies for the space environment utilization promotion projects; JEM utilization schedule; JEM utilization plans; space environment utilization database operation; status of experiment support technology development; plans for microgravity experiment, using sounding rocket (TR-1A); common experiment technologies to be developed and acquired by sounding rocket experiments; construction plan and structure of space experiment laboratory as part of the Space Station Integrated Project (SSIP) Center; IML-2 (International Microgravity Laboratory-2) project; international joint studies including Multilateral Science Working Group (MSWG), Space Station Spacelab Utilization Technology Working Group (UTWG), and International Space Life Science Strategic Planning Working Group (ISLSPWG); and JEM utilization case studies including pressurized module and exposed facility experiment equipment installation models. Author (NASDA)

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SPACECRAFT INSTRUMENTATION

A92-19427
THE HARD X-RAY TELESCOPE (HXT) FOR THE SOLAR-A MISSION

T. KOSUGI, S. MASUDA (Tokyo, University, Mitaka, Japan), K. MAKISHIMA, M. INDA (Tokyo, University, Japan), T. MURAKAMI, T. DOTANI, Y. OGAWARA (Institute of Space and Astronautical Science, Sagami, Japan), T. SAKAO, K. KAI, H. NAKAJIMA (National Astronomical Observatory, Mitaka, Japan) et al. *Solar Physics* (ISSN 0038-0938), vol. 136, Nov. 1991, p. 17-36. refs (Contract MOESC-01540214; MOESC-02452011)
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This study presents HXT, a Fourier-synthesis imager which takes images of solar flares simultaneously in four energy bands, with an ultimate angular resolution as fine as about 5 arcsec and a time resolution of 0.5 s. Each subcollimator has a field of view wider than the solar disk. The total effective area of the collimator/detector system reaches about 70 sq cm, about one order of magnitude larger than that of the Hinotori hard X-ray imager. These improvements enable HXT to take images of flares at photon energies above 30 keV. These higher-energy images are to be compared with lower-energy ones, giving clues to the understanding of nonthermal processes in solar flares, i.e., the acceleration and confinement of energetic electrons. It is of particular importance to specify the acceleration site with regard to the magnetic field figuration in a flaring region, which is to be achieved by collaborative observations between HXT and the soft X-ray telescope on board the same mission. P.D.

A92-19428* Tokyo Univ., Mitake (Japan).
THE SOFT X-RAY TELESCOPE FOR THE SOLAR-A MISSION
 S. TSUNETAKA (Tokyo, University, Mitaka, Japan), L. ACTON, M. BRUNER, J. LEMEN, W. BROWN, R. CARVALHO, R. CATURA, S. FREELAND, B. JURCEVICH (Lockheed Research Laboratories,

19 SPACECRAFT INSTRUMENTATION

Palo Alto, CA), J. OWENS (NASA, Marshall Space Flight Center, Huntsville, AL) et al. Solar Physics (ISSN 0038-0938), vol. 136, Nov. 1991, p. 37-67. Research supported by Lockheed Corp. refs

(Contract NAS8-37334)

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The Soft X-ray Telescope (SXT) of the SOLAR-A mission is designed to produce X-ray movies of flares with excellent angular and time resolution as well as full-disk X-ray images for general studies. A selection of thin metal filters provide a measure of temperature discrimination and aid in obtaining the wide dynamic range required for solar observing. The co-aligned SXT aspect telescope will yield optical images for aspect reference, white-light flare and sunspot studies, and, possibly, helioseismology. This paper describes the capabilities and characteristics of the SXT for scientific observing. Author

A92-19429

THE WIDE BAND SPECTROMETER ON THE SOLAR-A

M. YOSHIMORI, K. OKUDAIRA, Y. HIRASIMA, T. IGARASHI, M. AKASAKA, Y. TAKAI, K. MORIMOTO (Rikkyo University, Tokyo, Japan), T. WATANABE, K. OHKI (National Astronomical Observatory, Mitaka, Japan), J. NISHIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan) et al. Solar Physics (ISSN 0038-0938), vol. 136, Nov. 1991, p. 69-88. refs

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Attention is given to the wideband spectrometer (WBS) on board the Solar-A spacecraft. The WBS consists of three kinds of spectrometers - soft X-ray spectrometer (SXS), hard X-ray spectrometer (HXS), and gamma-ray spectrometer (GRS) - and is designed to investigate plasma heating, high-energy particle acceleration, and interaction processes. The SXS has two proportional counters and each counter provides 128-channel pulse height data in the 2-30-keV range every 2 s and 2-channel pulse count data every 0.25 s. The HXS has a NaI scintillation detector and provides 32-channel pulse height data in the 20-400-keV range every 1 s and 2-channel pulse count data every 0.125 s. The SXS observations make it possible to study the thermal evolution of flare plasma by obtaining time series of electron temperatures and emission measures of hot plasma; the HXS observations allow the study of electron acceleration and heating mechanisms by obtaining time series of the electron spectrum; and the GRS observations make possible the investigation of the high-energy electron and ion acceleration and interaction processes by obtaining time series of electron and ion spectra. P.D.

A92-19430

THE BRAGG CRYSTAL SPECTROMETER FOR SOLAR-A

J. L. CULHANE, R. D. BENTLEY (London, University College, Dorking, England), E. HIEL, T. WATANABE (National Astronomical Observatory, Tokyo, Japan), G. A. DOSCHEK, C. M. BROWN (U.S. Navy, Naval Research Laboratory, Washington, DC), A. M. CRUISE, J. LANG (Rutherford Appleton Laboratory, Abingdon, England), Y. OGAWARA (Institute of Space and Astronautical Science, Tokyo, Japan), Y. UCHIDA (Tokyo, University, Japan) et al. Solar Physics (ISSN 0038-0938), vol. 136, Nov. 1991, p. 89-104. Research supported by SERC, British National Space Centre, and U.S. Navy. refs

(Contract MOESC-63044163; MOESC-01044044)

Copyright

Attention is given to the BCS, one of the instruments comprising the scientific payload of the Solar-A mission. The spectrometer employs four bent germanium crystals, views the whole sun, and observes the resonance line complexes of H-like Fe XXVI and He-like Fe XXV, Ca XIX, and S XV in four narrow wavelength ranges with a resolving power of between 3000 and 6000. The spectrometer is approaching ten-times better sensitivity than that of previous instruments, thus permitting a time resolution of better than 1 s to be achieved. The principal aim of the instrument is the measurement of the properties of the 10-to-50-million-K plasma created in the solar flares, with special emphasis on the heating and dynamics of the plasma during the impulsive phase. P.D.

A92-23703

AUTONOMIC SPACECRAFT SYSTEM IN FUTURE

JUN-ICHI AOYAMA, MASAO FURUICHI, MASA-AKI KIMURA, YUKIO AMANO, KATSUO SINOZUKA, and KIMIO UCHIYAMA (NEC Corp., Kanagawa; NEC Aerospace Systems, Ltd., Yokohama, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 229-232. refs

The significance of the autonomic system is to reduce the burden of an earth station, and by reducing abnormal condition response time, make an effective use of limited spacecraft lifetime. One of the key elements of such self-diagnostic capabilities would be an inference system. Based on a knowledge data base equivalent to spacecraft experts, the inference system's function is to identify the cause of an abnormal condition from condition data monitors on each part of a spacecraft and take appropriate action. This report focuses on the inference system and introduces a few examples to meet the trends in the future spacecraft development. Author

A92-26838

TROPICAL RAINFALL MEASURING MISSION (TRMM) PROJECT. II - RESEARCH FOR THE OBSERVATION OF PRECIPITATION FROM SPACE AT COMMUNICATIONS RESEARCH LABORATORY

KEN'ICHI OKAMOTO and SHIGERU MIYAZAKI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 11, June 1990, p. 11-33. In Japanese. refs

Activities at the Communications Research Laboratory aimed at the development of a spaceborne rain radar are summarized. As the first step toward this aim, an airborne microwave rain scatterometer/radiometer system operating at 10 and 34.5 GHz has been developed for the remote sensing of rain from aircraft. The sensor system is described, and measurement results are presented. A new rain rate estimation algorithm for a dual-frequency radar has been developed and tested. Some possible rain radar designs are discussed. V.L.

A92-26843

TROPICAL RAINFALL MEASURING MISSION (TRMM) PROJECT. VI - SPACECRAFT, SCIENCE INSTRUMENTS, AND LAUNCHING ROCKET. PART 2 - ADVANCED VERY HIGH RESOLUTION RADIOMETER

HIROMICHI YAMASAKI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 11, June 1990, p. 77-81. In Japanese.

In this report the modified Advanced Very-High-Resolution Radiometer (AVHRR) for the TRMM (AVHRR-T) is discussed. The modification to the existing AVHRR can be accommodated to the requirements without major instrument redesign except for the radiant cooler, relay optics, and some electronics. The increased instantaneous field of view requirements for the AVHRR-T require the redesign of the relay optics to provide unvignetted optical performance. The TRMM orbit requires a radiant-cooler concept which operates in the nonsun-synchronous orbit. The radiant cooler operates at 115 K with a 7 K margin, and the AVHRR-T uses the same scan subsystem as that of the AVHRR-3 on NOAA satellites. The only difference is that the scan-mirror rotation is 401 rpm for AVHRR-T compared to 360 rpm for AVHRR-3 without any reductions in performance. Author

A92-32118* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.

LASER ATMOSPHERIC WIND SOUNDER (LAWS) PERFORMANCE ANALYSIS

D. KENYON and J. PETHERAM (General Electric Co., Astro-Space Div., Philadelphia, PA) IN: Symposium on Meteorological Observations and Instrumentations, 7th, New Orleans, LA, Jan. 14-18, 1991, Preprints. Boston, MA, American Meteorological Society, 1991, p. 463-467. Research supported by NASA. Copyright

The science objectives of the NASA's Laser Atmospheric

Sounder (LAWS) are discussed, and results of the performance analysis of the LAWS system are presented together with the instrument configuration used for these performance analyses. The results of analyses show that the science requirements for the wind-velocity accuracies of m/sec in the lower troposphere and 5 m/sec in the upper troposphere will be met by the present design of the LAWS system. The paper presents the performance estimates of the LAWS in terms of the global coverage, spatial resolution, signal-to-noise ratio, line-of-sight velocity error, and horizontal inversion accuracy. I.S.

A92-35044* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

IMPROVED LIMB ATMOSPHERIC SPECTROMETER (ILAS) FOR POLAR STRATOSPHERIC TRACE GAS MEASUREMENTS
TATSUYA YOKOTA, MAKOTO SUZUKI, YASUHIRO SASANO (National Institute for Environmental Studies, Tsukuba, Japan), AKIYOSHI MATSUZAKI (Institute of Space and Aeronautical Science, Sagami-hara, Japan), JAE H. PARK (NASA, Langley Research Center, Hampton, VA), and KAZUYA ASADA (Japan Environment Agency, Tokyo) IN: IGARSS '91: Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 939-942. refs

Copyright

The Improved Limb Atmospheric Spectrometer (ILAS) is a grating spectrometer designed to measure vertical profiles of high latitude stratospheric constituents in a solar occultation mode. ILAS measurement gases are ozone (O₃), methane (CH₄), nitrous oxide (N₂O), nitric acid (HNO₃), water vapor (H₂O), nitrogen dioxide (NO₂), and CFC-11 using an IR channel. Temperature, pressure, and aerosol are also measured using a visible channel. The IR channel consists of 44 detector elements which cover the spectral range 6.2 to 11.8 microns, and the visible channel is composed of 1024 pixels that cover 753 to 784 nm. ILAS will be installed on the Advanced Earth Observing Satellite (ADEOS) which will be launched in 1995. Instrument design data are outlined. I.E.

A92-38970

COLLECTIVE-PROCESSING CORRELATOR SYSTEM FOR IMAGING RADIOMETER OF THINNED ARRAYS

K. KOMIYAMA, Y. KATO, and T. IWASAKI (MITI, Light Technology Div., Tsukuba, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 8, April 9, 1992, p. 779-781. refs

Copyright

A correlation processor is proposed for interferometric microwave radiometers of thinned arrays. In this system, each antenna signal is frequency-shifted by local signals of different frequency. These signals are gathered and processed collectively to generate correlation signals between all pairs of antennas. A conceptual design of the collective-processing correlator for a six-antenna thinned array is shown. Author

A92-41620

ACCURACY OF IN-FLIGHT CALIBRATION OF THE WATER-VAPOUR CHANNEL OF A SATELLITE RADIOMETER BY RADIANCE CALCULATION

Y. TAKAYAMA (Meteorological Research Institute, Tsukuba, Japan) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, no. 8, May 20, 1992, p. 1537-1548. refs

Copyright

The accuracy of a calibration of a water-vapor channel of a radiometer on board a satellite by using a radiative transfer code with radiosonde profiles was examined with the aid of the calibrated WV channel data of the Visible and Thermal Infrared Radiometer (VTIR) on the MOS-1 satellite. It has been verified that the assumption that a linear extrapolation for the relative humidity in the upper troposphere was reasonable for estimating the radiances in the water-vapor channel by a comparison of the brightness temperatures of the channel measured by the calibrated VTIR with those calculated by the radiative transfer code. An error in water-vapor distribution of radiosonde data considerably affected

the estimated brightness temperature by the radiance calculation in the water vapor absorption band. The accuracy of the calibration of the water-vapor channel by the radiance calculation was with the root-mean-square (rms) temperature difference of 3.96 C.

Author

A92-42394

POSITION LINEARITY AND RESOLUTION OF LARGE POSITION-SENSITIVE SILICON DETECTOR WITH A HIGHLY UNIFORM THICKNESS

NOBUYUKI HASEBE (Ehime University, Matsuyama, Japan), TADAYOSHI DOKE, TOSHISUKE KASHIWAGI, SATOSI KATAOKA, JUN KIKUCHI (Waseda University, Tokyo, Japan), HITOSHI MORIYA (Ehime University, Matsuyama, Japan), KYOSHI NISHIJIMA (Tokai University, Tokyo, Japan), and HENRY J. CRAWFORD (California, University, Berkeley) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1191-1193. Research supported by Institute of Space and Astronautical Science. refs

Copyright

Basic characteristics of large position-sensitive silicon detectors (PSDs) developed for the High Energy Particle Experiment telescope (to be flown aboard the GEOTAIL satellite scheduled for a launch in July 1992) are described. The telescope consists of two identical PSDs of an effective area of 62 mm x 62 mm and a thickness of 500 microns, and multiple Si(Li) detectors, which will measure energy losses and particle trajectories of Fe ions. It is shown that the PSDs are capable of separating iron isotopes with a mass resolution of 0.23 amu. I.S.

A92-45423

A RATIONAL APPROACH TO HIGH-RELIABILITY, HIGH-PERFORMANCE, LOW-COST SPACEBORNE DATA MANAGEMENT SYSTEMS

LYNN S. DIAMANT (IBM Japan, Ltd., Tokyo) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 535-534.

(SAE PAPER 912037) Copyright

There is a trend in modern space systems to contain as much of the data processing function in the spaceborne component as possible. This relieves much of the operational burden of the ground support systems, but places inordinate requirements on the spaceborne systems. Future systems will need orders of magnitude improvements in processing power, reliability/availability and function while requiring equal decreases in cost, weight, and power consumption. These considerations will shape the technologies and architectures of spaceborne data processing systems for the foreseeable future. Author

A92-48228

EVALUATION OF SURFACE CLUTTER FOR THE DESIGN OF THE TRMM SPACEBORNE RADAR

HIROSHI HANADO and TOSHIO IHARA (Communications Research Laboratory, Kashima, Japan) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 30, no. 3, May 1992, p. 444-453. refs

Copyright

A quantitative examination is made of surface clutter interference on spaceborne rain radar due to antenna sidelobes, with a view to the clarification of antenna design criteria. The intensities of both rain echo and sea clutter are numerically evaluated with suitable precipitation and sea-surface scattering models, as well as a realistic phased-array antenna pattern. Results indicate that a region exists just above the sea surface where clutter masks the backscattered power from the rain. For a 17-deg incidence angle, this region extends to an altitude of about 1.2 km. O.C.

A92-53581

DEVELOPMENT OF BUBBLE MEMORY RECORDER ONBOARD JAPAN EARTH RESOURCES SATELLITE-1

19 SPACECRAFT INSTRUMENTATION

TSUNEHICO ARAKI, CHU ISHIDA (NASDA, Tokyo, Japan), KIYOSHI OCHIAI (Misubishi Electric Corp., Kamakura, Japan), TATSUHIRO NOZUE, KYOZO TACHIBANA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), and KAZUTOSHI YOSHIDA (Hitachi, Ltd., Mobara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 933-938.

Copyright

The Bubble Memory Recorder (BMR) developed for use on the Earth Resources Satellite is described in terms of its design, capabilities, and functions. The specifications of the BMR are given listing memory capacity, functions, and interface types for data, command, and telemetry functions. The BMR has an emergency signal interface to provide contingency recording, and a satellite-separation signal interface can be turned on automatically by signal input. Data are stored in a nonvolatile memory device so that the memory is retained during power outages. The BMR is characterized by a capability for random access, nonvolatility, and a solid-state design that is useful for space operations since it does not disturb spacecraft attitude. C.C.S.

A92-53582

DEVELOPMENT OF DATA RECORDER ONBOARD JAPAN SPACE FLYER UNIT

NOBORU WAKASUGI, SHINOBU MATSUOKA (Institute for Unmanned Space Experiment Free Flyer, Tokyo, Japan), TAKAHIRO YAMADA (Institute of Space and Astronautical Science, Sagami-hara, Japan), TATSUHIRO NOZUE, KYOZO TACHIBANA, KAZUO KOJIMA, RITSUKO FUKADA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), and KAZUTOSHI YOSHIDA (Hitachi, Ltd., Mobara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 939-944.

Copyright

A multifunctional data recorder for use on the Japanese Space Flyer Unit is described with attention given to the structure and uses of the device. The recorder is a 4-Mbits magnetic bubble-memory device with two recorders for both high- and low-data-rate input. The devices comprise bubble memories, LSIs for memory control, and peripheral circuits for processing commands, telemetry, and the data source. The basic block diagram is given, and major specifications are given such as recording rates, memory capacity, and telemetry compatibility. The solid state design affords correction of data errors, and the unit is shown to have a low power requirements. The modular design enhances reconfigurability, and the data recorder is protected against latchup by means of a limiting circuit. C.C.S.

A92-53583

ON ORBIT PERFORMANCE OF BUBBLE DATA RECORDERS ON SCIENTIFIC SATELLITES

TOMONAO HAYASHI, FUMIYOSHI MAKINO, KOICHIRO TSURUDA, ICHIRO NAKATANI (Institute of Space and Astronautical Science, Sagami-hara, Japan), TATSUHIRO SEKI, KYOZO TACHIBANA, MASAHICO IKEDA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), and KAZUTOSHI YOSHIDA (Hitachi, Ltd., Mobara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 945-950. refs

Copyright

The performance of two bubble data recorders (BDRs) in orbiting spacecraft is discussed. One BDR was installed in the scientific satellite Ginga and has been in service for three years, and a second BDR with 64 Mbits of memory was deployed with the scientific satellite Akebono approximately 1 yr ago. The BDRs are described, and specific attention is given to the high radiation specification of 100 krad for the Akebono BDR to account for the highly eccentric polar orbit. Both BDR units are said to be functioning normally, and some samples of real-time data from the BDRs are given that correspond to solar flares. The BDRs

functioned normally during and after the solar flares with no latch-ups reported, and the Ginga BDR is shown to be fully operational after 19,000 hrs of use. C.C.S.

A92-53610

GROUND VERIFICATION OF THE ETS-VI ANTENNA POINTING CONTROL SYSTEM

HIROSHI TANAKA, HIROSHI HOJO, KENJI UENO, and YOICHI KAWAKAMI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1137-1142. refs

Copyright

This paper describes new verification ground tests for the ETS-VI antenna pointing control system. The testing methods for this highly accurate control system, which has a precise antenna pointing mechanism and a radio frequency sensor using 3.5-mphi reflector, take gravity compensation, simulated orbital environments, and satellite body fluctuations into account. The control performances of the system can be estimated from the resulting ground tests data. Author

A92-53729

STUDY ON EARTH GLOBAL CHANGE MONITORING SYSTEM FOR NEXT GENERATION

TAKASHI MORIYAMA, MASAKATSU NAKAJIMA (NASDA, Tsukuba Space Center, Japan), MAKOTO SUZUKI, and NOBUO TAKEUCHI (National Institute for Environmental Studies, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1977-1981. refs

Copyright

Results are presented from the preliminary design studies for the Advanced Limb Atmospheric Spectrometer (A-LAS) and High-resolution Limb Atmospheric Spectrometer (H-LAS); these spaceborne instruments employ thermal-IR CCDs and grating spectrometer technologies. NASDA has developed two types of IR CCDs, respectively, using a heterobarrier detection mechanism and a Schottky barrier detection mechanism. An analysis is conducted of preliminary results obtained by these technologies for the vertical profiles of minor atmospheric constituents. O.C.

A92-55574

CONCEPTUAL STUDY ON AND TRIAL MODEL FOR FORTHCOMING VERY HIGH RESOLUTION VISIBLE AND NEAR INFRARED RADIOMETERS

RIICHI NAGURA, MASARU HIRAMATSU, and KAZUHIRO OGIKUBO (NEC Corp., Space Development Div., Yokohama, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. Research supported by MITI, Japan Resources Observation System Organization, and NASDA. refs

(IAF PAPER 92-0085) Copyright

The paper describes the salient features of a prospective Japanese spaceborne visible and NIR radiometer, named Super VNIR, which meets all requirements in the earth observation field and which is considered for operation during the years 2000 to 2005. The Super VNIR's features include high-resolution imaging, which will be sufficiently sharp for use in city planning; along-the-track stereoscopic imaging, which can eliminate the effects of changes in the local weather conditions; autonomous radiometer control techniques for simple and convenient operation; light weight and small-sized design; and high-quality images supported by highly reliable fine-pitch CCD. I.S.

SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

A92-12490**JEM ELECTRICAL POWER SYSTEM ARCHITECTURE**

TAKEHIKO KATO (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p.

(IAF PAPER 91-083) Copyright

The architecture of the Japanese Experiment Module Electrical Power System (JEM EPS) designed for the Space Station Freedom is described and its requirements are documented. The relationship between the physical and functional aspects of the EPS are explained using a specially designed matrix representation. Special attention is given to the relationship between the EPS architecture to other subsystems of the Space Station Manned Base. I.S.

A92-13151**DEVELOPMENT STATUS OF THE LIQUID APOGEE PROPULSION SYSTEM**

SHINGO MURAYAMA, HIDEYUKI KOBAYASHI, KOJI TERADA (NASDA, Tokyo, Japan), MASAKAZU SATO, KOICHI MIYOSHI, YUICHI HAYASAKA, and KANJI OHNISHI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs

(IAF PAPER 91-255) Copyright

A report is presented of the liquid apogee propulsion system (LAPS) being developed for the engineering test satellite ETS-VI, a pressure fed, full blowdown bipropellant propulsion system utilizing hydrazine and nitrogen tetroxide as propellant. The design goal of LAPS is the development of a propulsion system capable of placing a two ton-class satellite into geostationary orbit by multiple-burn operation. R.E.P.

A92-13153**DEVELOPMENT STATUS OF H-II ROCKET CRYOGENIC PROPULSION SYSTEMS**

AKIRA KONNO, MAMORU ENDO, YUKIO KOYARI, and YOSHIO YAMADA (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs

(IAF PAPER 91-263) Copyright

Test results and the current development status of the cryogenic propulsion systems for the H-II launch vehicle are presented. Based on earlier developmental experience both the first and second stages of the H-II utilize advanced cryogenic propulsion systems to inject a four ton-class payload into geostationary transfer orbit. Attention is given to system descriptions, a summary of major technical problems experienced, vibration and acoustic tests, and component qualification tests. R.E.P.

A92-17204**REAL-GAS EFFECT ON THE MAGNETOPLASMADYNAMIC ARCJET**

K. TOKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) and M. SUMIDA Journal of Propulsion and Power (ISSN 0748-4658), vol. 7, Nov.-Dec. 1991, p. 1072-1074. Previously cited in issue 16, p. 2464, Accession no. A87-38023. refs

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A92-17809#**A CONCEPT OF LACE FOR SSTD SPACE PLANE**

M. TOGAWA, T. AOKI, H. HIRAKOSO (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), and T. ITO (NASDA, Tokyo, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 7 p. refs

(AIAA PAPER 91-5011) Copyright

A liquified air-cycle engine (LACE) is proposed for two SSTD

spacecraft concepts, one of which is combined with a Scram propulsion system. The principle of LACE combustion is based on replacing the oxidizer with air liquified by heat exchange with cryogenic propellants. A suitable LACE for a reusable SSTD spacecraft requires high specific impulse particularly at low ram conditions. The LACE cycle is therefore designed to maximize the liquefaction ratio and incorporates fuel-boost, fuel-main, air-main, and oxygen-boost pumps and an air compressor. A calculation of total air liquefaction is given for the proposed vehicle and engine configurations, and the main characteristics of the SSTD LACE and SSTD LACE/Scram concepts are listed. The LACE/Scram concept requires a lower mass ratio and is considered a viable proposal because it can be employed in conjunction with existing technologies. C.C.S.

A92-21064**MULTICHANNEL TWO-DIMENSIONAL MAGNETOPLASMADYNAMIC ARCJET**

K. TOKI, K. KURIKI (Institute of Space and Astronautical Science, Kanagawa, Japan), and M. SUMIDA Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, Jan.-Feb. 1992, p. 93-97. Previously cited in issue 17, p. 2637, Accession no. A87-39627. refs

Copyright

A92-21065**ELECTROMAGNETIC EFFECTS IN AN APPLIED-FIELD MAGNETOPLASMADYNAMIC THRUSTER**

Y. ARAKAWA (Tokyo, University, Japan) and A. SASOH (Tohoku University, Sendai, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, Jan.-Feb. 1992, p. 98-102. refs

Copyright

Experimental and analytical studies have been conducted on the performance and thrust production mechanisms of an applied-field magnetoplasmadynamic thruster. The thruster was able to run with a high-thruster performance due to large electromagnetic effects related to the applied magnetic field. Using hydrogen, helium, and argon as the propellant, over 20 percent thrust efficiency was obtained over a wide specific impulse range from 1000 to 7000 s at input power levels between 2.2 and 15.9 kW. From the measurements of performance characteristics and current densities in the acceleration region, and by a theoretical analysis, it is found that the thruster operation is characterized by a parameter, $B\text{-squared}/m$ (B : applied magnetic field strength, m : propellant mass flow rate). Author

A92-21067**THREE-DIMENSIONAL NUMERICAL MODEL OF ION OPTICS SYSTEM**

YUKIO HAYAKAWA (National Aerospace Laboratory, Chofu, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, Jan.-Feb. 1992, p. 110-117. Previously cited in issue 19, p. 3008, Accession no. A90-42612. refs

Copyright

A92-21068**MEASUREMENTS OF ELECTRON ENERGY DISTRIBUTIONS IN AN ION THRUSTER**

Y. HAYAKAWA, K. MIYAZAKI, and S. KITAMURA (National Aerospace Laboratory, Chofu, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, Jan.-Feb. 1992, p. 118-126. Previously cited in issue 20, p. 3123, Accession no. A89-47038. refs

Copyright

A92-28510**STATUS OF H-II ROCKET FIRST STAGE PROPULSION SYSTEM**

H. NAGAI, K. NODA (NASDA, Tokyo, Japan), I. YAMAZAKI, and T. MORI (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, Mar.-Apr. 1992, p. 313-319. Previously cited in issue 18, p.

20 SPACECRAFT PROPULSION AND POWER

3018, Accession no. A88-44701. refs
Copyright

A92-31709#

BENEFITS OF ELECTRIC PROPULSION FOR ORBIT INJECTION OF COMMUNICATION SPACECRAFT

F. PORTE, P. SAINT AUBERT, and C. BUTHION (Matra Marconi Space, Villacoublay, France) AIAA, International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992. 10 p. Research sponsored by INTELSAT. (AIAA PAPER 92-1955) Copyright

This paper presents an analysis of the benefits of electric propulsion (Xenon Ion Propulsion systems and Thermal Arcjets) when applied to the orbit raising of communication spacecraft. Three different injection strategies are proposed and assessed. The impacts on the spacecraft design and the associated dry mass penalties are introduced in the analysis. Finally, the benefits in terms of launch cost reduction or payload extension are discussed. Author

A92-35613

BUILT-IN-TEST OF THE ELECTRIC POWER SECTION OF THE JAPANESE EXPERIMENT MODULE (JEM)

MASAAKI KOMATSU (NASDA, Tokyo, Japan), T. GOUCHI, and SHOICHI SUZUKI (Mitsubishi Electric Corp., Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 21, 22. In Japanese. refs

A92-35920

RECENT TRENDS OF LIQUID ROCKET ENGINES FOR EARTH-TO-ORBIT TRANSPORTATION

AKIO SUZUKI and HIROSHI MIYAJIMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 234-238. In Japanese. refs

Combustor designs of the Space Shuttle Main Engine (SSME) are examined. The first stage engine LE-7 of H-II launch vehicle is discussed, and the advanced launch system (ALS) propulsion system is outlined. Y.P.Q.

A92-35922

PERSPECTIVE ON FUTURE SPACE PROPULSION

YOSHIHIRO ARAKAWA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 248-251. In Japanese. refs

The fundamental characteristics and advantages of nonchemical propulsion systems are studied. Electric propulsions such as arcjet and magnetoplasmadynamic are emphasized. Solar and nuclear propulsion is also considered. Y.P.Q.

A92-36970

THRUST PERFORMANCE OF A REGENERATIVELY COOLED LOW-POWER ARCJET THRUSTER

TETSUYA YAMADA, YUKIO SHIMIZU, KYOICHIRO TOKI, and KYOICHI KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 650-654. Previously cited in issue 19, p. 3005, Accession no. A90-42561. refs
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A92-40443

ROCKET EXPERIMENT METS - MICROWAVE ENERGY TRANSMISSION IN SPACE

N. KAYA (Kobe University, Japan), H. MATSUMOTO (Kyoto University, Japan), and R. AKIBA (Institute of Space and Aeronautical Science, Sagami-hara, Japan) IN: SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Gif-sur-Yvette, France, Aug. 27-30, 1991. Paris, Societe des Electriciens et des Electroniciens and Societe des Ingenieurs et Scientifiques de France, 1991, p. 336-342. refs

A Microwave Energy Transmission in Space (METS) rocket experiment is being planned by the Solar Power Satellite Working Group at the Institute of Space and Astronautical Science in Japan for the forthcoming International Space Year, 1992. The METS

experiment is an advanced version of the previous MINIX rocket experiment (Matsumoto et al., 1990). This paper describes a conceptual design of the METS rocket experiment. It aims at verifying a newly developed microwave energy transmission system for space use and to study nonlinear effects of the microwave energy beam in the space plasma environment. A high power microwave of 936 W will be transmitted by the new phased-array antenna from a mother rocket to a separated target (daughter rocket) through the ionospheric plasma. The active phased-array system has a capability of focusing the microwave energy around any spatial point by controlling the digital phase shifters individually. Author

A92-40448

A FEASIBILITY STUDY OF POWER SUPPLYING SATELLITE (PSS)

H. MATSUMOTO (Kyoto University, Japan), N. KAYA (Kobe University, Japan), S. KINAI, T. FUJIWARA (Nissan Motor Co., Tokyo, Japan), and J. KOCHIYAMA (Rocket System Corp., Tokyo, Japan) IN: SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Gif-sur-Yvette, France, Aug. 27-30, 1991. Paris, Societe des Electriciens et des Electroniciens and Societe des Ingenieurs et Scientifiques de France, 1991, p. 375-380. refs

A feasibility study is given on a new type of orbiting power station which supplies a power of the order of 100 kw to orbiting customers (satellites or space stations). This power supplying satellite (PSS) is composed of three main parts: a power generator, a power transmitter and a satellite bus system. The unique feature of the proposed PSS is the usage of a module which has a solar-cell array on one side and a microwave transmitting antenna array driven by FET-amplifiers on the other side. These autonomous transmitter modules are used to form a large disk-structured active phased array of 40 m diameter which transmits a 100 kw energy beam of 24 GHz microwave. The frequency of 24 GHz is chosen to reduce the size and volume of the transmitting antenna. dc electric power generated by the solar cells on the top plane of the module is fed directly to the semiconductor FET amplifiers located under the solar-cells, converted to 24 GHz microwave, and then transmitted from the antenna arrays on the bottom plane of the module. These autonomous solar-cell-transmitter modules make it possible to eliminate the rotary joint and the dc power collecting network from the design of the PSS and SPS system. The PSS provides the following advantages: (1) availability of high power electricity to orbiting customer satellites or stations; (2) reduction of weight and volume of power system on customer space vehicles; and (3) technical go-forward for the future SPS. Author

A92-44756

A LIGHT AND HIGH-EFFICIENCY TWT POWER SUPPLY FOR A COMMUNICATIONS SATELLITE

TAKASHI YAMASHITA, SATOSHI OHTSU, KATSUHIKO YAMAMOTO, and TOSHIYUKI SUGIURA (NTT, Interdisciplinary Research Laboratories, Tokai, Japan) NTT Review (ISSN 0915-2334), vol. 4, no. 3, May 1992, p. 56-62. refs
Copyright

A new technique for designing high-voltage transformers and choke coils to reduce power loss by transformer stray capacitance is presented. A heater inverter is simplified, and surface mount technology is applied to a control circuit and the heater inverter. The efficiency of the new TWT power supply is increased to 82 percent at a switching frequency of 200 kHz and the power supply weighs approximately 70 percent of the conventional power supply. R.E.P.

A92-47956

PROCESS AND CONSIDERATION OF SOLAR PANEL CURRENT OF GMS-3/4 USING SOLAR PANEL CURRENT REGULARIZATION PROGRAM

TOSHIHIRO NISHIDA, YUJI OHASHI, and KAZUO SEKINE Meteorological Satellite Center, Technical Note (ISSN 0388-9653), no. 23, Nov. 1991, p. 71-81. In Japanese. refs

Since 1989 there has been a considerable downslide that is due to large scale solar flare in the solar panel current of GMS-3/4. A case of the considerable downslide in the solar panel current of GMS-3/4 is described. R.E.P.

A92-48387
INTERNATIONAL THRUSTS IN LAUNCH VEHICLE PROPULSION

DONALD R. CONNELL (Pratt & Whitney Group, West Palm Beach, FL), HANS IMMICH (MBB GmbH, Munich, Federal Republic of Germany), and GHANSHYAM P. PUROHIT (Hughes Aircraft Co., Space and Communications Group., El Segundo, CA) Aerospace America (ISSN 0740-722X), vol. 30, no. 7, July 1992, p. 42-46. Copyright

A development status evaluation is presented for the launch vehicle propulsion systems either being operated or developed by the Commonwealth of Independent States, ESA, and Japan. Representative systems are the 100-ton-payload-lifting Energiya, whose RD-10 liquid rocket engines are produced in both expendable and reusable forms; the H-II, whose LE-7 LOX/LH₂-fueled engines use a staged-combustion cycle; and the monomethyl hydrazine/N₂O₄-fueled Ariane V, whose Vulcain engine's design emphasizes safety and reliability as well as low cost. O.C.

A92-48767#
HYDRAULIC AND MECHANICAL PERFORMANCE OF LE-7 LOX PUMP INDUCER

KENJIRO KAMIJO, MAKOTO YOSHIDA (National Aerospace Laboratory, Kakuda, Japan), and YOSHINOBU TSUJIMOTO (National Aerospace Laboratory, Kakuda; Osaka University, Toyonaka, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 9 p. refs

(AIAA PAPER 92-3133) Copyright

A liquid oxygen turbopump has been developed for the main engine (LE-7) of the H-II rocket. The LE-7 LOX pump requires an inducer with quite high suction performance and high head, because a low-speed and low-pressure pump is not used ahead of the main pump in the LE-7 engine. The inducer was designed using the customary method and its hydraulic and mechanical performances were investigated in tests of LE-7 LOX turbopumps. The original combination of an inducer and an inducer housing satisfied the required hydraulic performance criteria. However, this combination was found to result in supersynchronous shaft vibrations due to rotating cavitation which occurred in the inducer. This problem was almost completely solved by a simple modification of the inducer upstream housing. Furthermore, the rotating cavitation of the present inducer was investigated using a new theory of such cavitation proposed by Tsujimoto, et al.

Author

A92-48774#
CYCLIC TEST OF A 14-CM DIAMETER RING-CUSP XENON ION THRUSTER

S. KITAMURA, K. MIYAZAKI, and Y. HAYAKAWA (National Aerospace Laboratory, Chofu, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 11 p. refs

(AIAA PAPER 92-3146) Copyright

Results are presented on a cyclic operation test on a 14-cm-diam ring-cusp Xe ion thruster, conducted in order to reveal weak points in the thruster endurance, to estimate thruster endurance, and to evaluate the test facility and the procedure. The thruster was operated to produce a thrust of 25 mN at the beam voltage of 1 kV. A 3-hr operation was followed by a 1.5-hr nonoperation period, and the procedure repeated for 613 cycles, with 1859 hrs of beam exhausting time. No critical problems were seen for the thruster except for the neutralizer. Compared with the previous 1000-hr continuous operation test, the amount of metal flakes in the discharge chamber was reduced, although the main cathode tip parts still suffered significant erosion. The erosion of the screen grid was negligible. I.S.

A92-48775#

PERFORMANCE TEST OF A 14 CM XENON ION THRUSTER

Y. HAYAKAWA, K. MIYAZAKI, and S. KITAMURA (National Aerospace Laboratory, Chofu, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 9 p. refs

(AIAA PAPER 92-3147) Copyright

The results of the performance tests of an 14-cm xenon ion thruster are described. Three kinds of ion-optics systems were applied to the ion thruster and thruster performances were measured. The accelerator-grid holes of the original ion-optics system had seemed to be nibbled by ion beamlets because of excessive grid-hole displacements in the rim region. Two other ion-optics systems were designed to reduce the ion impingement and the purpose of the tests was to seek how far the thruster performance would be improved with the modified ion-optics systems. The tests were annoyed by kinds of discharge instabilities of which reason had not yet been found out. Consequently the performance difference was not revealed clearly; however, an ion-optics system is recommended for another reasons. This paper also describes the results of doubly-charged ion measurements which are available to correct the thruster performance. Author

A92-48814#

THEORETICAL ANALYSIS OF ROTATING CAVITATION IN ROCKET PUMP INDUCERS

YOSHINOBU TSUJIMOTO, KENJIRO KAMIJO (National Aerospace Laboratory, Kakuda, Japan), YOSHIKI YOSHIDA (Osaka University, Toyonaka, Japan), and YOSHIKI YOSHIDA AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 10 p. refs

(AIAA PAPER 92-3209) Copyright

Rotating cavitation was analyzed using an actuator disk method. Quasi-steady pressure performance of the impeller, mass flow gain factor and cavitation compliance of the cavity were taken into account. Three types of destabilizing modes were observed: rotating cavitation propagating faster than the rotational speed of the impeller, rotating cavitation propagating in the direction opposite that of the impeller, and rotating stall propagating slower than the rotational speed of the impeller. It was shown that both types of rotating cavitations were caused by the positive mass flow gain factor, while the rotating stall was caused by the positive slope of the pressure performance. Stability and propagation velocity maps are presented for the two types of rotating cavitations in the mass flow gain factor-cavitation compliance plane. The correlation between theoretical results and experimental observations is discussed. Author

A92-50562

BRAYTON-RANKINE TOTAL ENERGY SPACE DYNAMIC POWER SYSTEM ANALYSIS

ZHI-GUANG LING (Institute of Space and Astronautical Science, Sagami-hara; Shanghai University of Engineering Science, People's Republic of China) and KOICHI OSHIMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 1. La Grange Park, IL, American Nuclear Society, 1991, p. 235-240. Previously announced in STAR as N92-20924. refs

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A study was made on the combined Brayton-Rankine total energy space dynamic power system. Thermodynamic analysis and comparative calculation were performed for the system and the regenerative Brayton system. Results show that under the space conditions even with water as the working fluid of the Rankine part, the thermal efficiency could be raised by 5 to 10 percent at the working point, in comparison with a regenerative Brayton system and with the existing technology for the Rankine system alone. An increase in steam turbine and pumps in comparison with regenerative Brayton system brought no significant reduction in system weight. Through radiator area analysis, the suggested total energy system shows no significant increase in radiation area. The spray radiator is more suitable for this purpose.

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Further conceptional projective study is needed to proceed in the optimization of parameters and appropriate working substance together with the spray radiator condenser design considerations.

Author

A92-50640 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ADVANCED POWER SYSTEMS FOR EOS

SHEILA G. BAILEY, IRVING WEINBERG, and DENNIS J. FLOOD (NASA, Lewis Research Center, Cleveland, OH) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 2. La Grange Park, IL, American Nuclear Society, 1991, p. 250-255. Previously announced in STAR as N91-31217. refs (Contract RTOP 506-41-11)

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The Earth Observing System (EOS), which is part of the International Mission to Planet Earth, is NASA's main contribution to the Global Change Research Program. Five large platforms are to be launched into polar orbit: two by NASA, two by the European Space Agency, and one by the Japanese. In such an orbit the radiation resistance of indium phosphide solar cells combined with the potential of utilizing 5-micron cell structures yields an increase of 10 percent in the payload capability. If further combined with the Advanced Photovoltaic Solar Array, the total additional payload capability approaches 12 percent.

Author

A92-53189

IN-ORBIT PERFORMANCE OF HUGHES HS 393 SOLAR ARRAYS

STEVEN W. GELB and LELAND J. GOLDHAMMER (Hughes Aircraft Co., El Segundo, CA) IN: IEEE Photovoltaic Specialists Conference, 22nd, Las Vegas, NV, Oct. 7-11, 1991, Conference Record. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1429-1433. refs

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The synchronous orbit performance of the HS393 spacecraft solar arrays employing K4 3/4 and K7 solar cells is presented and compared with ground-based computer predictions for orbital durations greater than two years. The HS393 spacecraft discussed include the Japan Communications Satellite Company JCSAT-1 and JCSAT-2, and the Hughes Communications SBS-6. The in-space performance data indicate fixed solar panel bus 1 power degradation of 6.4 percent for JCSAT-1 after 26 months in orbit, 2.6 percent for JCSAT-2 after 16 months in orbit, and 2.0 percent for SBS-6 after 6 months in orbit. The predicted output of each of these solar arrays is within 2.5 percent of the actual output as obtained through telemetry data. I.E.

A92-53206

HIGH EFFICIENCY SILICON SOLAR CELLS FOR SPACE USE

M. UESUGI, T. NOGUCHI (NASDA, Tsukuba, Japan), T. KATSU, Y. TONOMURA, T. HISAMATSU, T. SAGA, and A. SUZUKI IN: IEEE Photovoltaic Specialists Conference, 22nd, Las Vegas, NV, Oct. 7-11, 1991, Conference Record. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1521-1525. refs

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High-efficiency silicon solar cells for space use were developed, and the manufacturing process was established. The maximum size of these cells is 4 x 6 cm. The cells have fine grid patterns formed by photolithography and lift-off technique. Obtained AM0 efficiencies of 50-, 70- and 100-micron-thick 4 x 6 cm BSFR cells at 28 C were 14.3 percent, 14.5 percent, and 14.8 percent, respectively. Those of 200-micron BSR cells with 10-Ohm-cm substrate and 2-Ohm-cm substrate were 12.7 percent and 13.6 percent, respectively. Work to increase the electrical output of these cells is discussed. At present non-texturized 100-micron cells show 16.1 percent and texturized 200-micron cells show 17.3 percent. I.E.

A92-53217

ANALYSIS OF SPACE FLIGHT DATA OF INP SOLAR CELLS IN EXOS-D ORBIT

M. YAMAGUCHI (NTT, Opto-Electronics Laboratories, Tokai, Japan), T. HAYASHI, A. USHIROKAWA, K. TAKAHASHI (Institute of Space and Astronautical Science, Sagami-hara, Japan), T. TAKAMOTO, H. OKAZAKI, M. OHMORI (Nippon Mining Corp., Toda, Japan), S. IKEGAMI, and H. ARAI (NEC Corp., Yokohama, Japan) IN: IEEE Photovoltaic Specialists Conference, 22nd, Las Vegas, NV, Oct. 7-11, 1991, Conference Record. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1576-1581. refs

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Flight data of InP solar cells in the EXOS-D orbit (in a high-altitude polar orbit) have been analyzed based on the effects of proton and electron irradiation on them. Good agreement between analytical results and flight data for InP solar cell properties in the EXOS-D orbit shows the validity of the analytical model and that this analytical model is useful for designing space power systems using InP cells in other orbits with known radiation environments. The InP solar cells are concluded to be applicable to space cells, especially in severe radiation environments. I.E.

A92-53461

POPPING TEST OF HYDRAZINE/NTO INJECTORS FOR A 2000N THRUST APOGEE ENGINE

YUKIO KURODA, MAKOTO TADANO, HIROSHI MIYAJIMA (National Aerospace Laboratory, Kakuda, Japan), HIDEYUKI KOBAYASHI (NASDA, Tokyo, Japan), SIGEYASU IIHARA, and HIROYUKI BAN (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 81-88. refs

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A pressure-fed, blowdown, hydrazine/NTO apogee propulsion system has been chosen for the ETS-VI to be launched by the H-II rocket in 1993. Experimental studies were conducted to determine the pop and pop-free regions of injectors used in development tests of this 2000N thrust engine. A threshold fuel Reynolds number was found below which no pops were observed at any chamber pressure. The popping region curve in the chamber pressure-reference plane had two branches: an upper and a lower. Popping frequency increased when the operating point was located deeper in the popping region. C.D.

A92-53462

THERMAL PROBLEMS RELATED TO BLOWDOWN OPERATION OF A HYDRAZINE FILM COOLED BI-PROPELLANT APOGEE ENGINE

HIROSHI MIYAJIMA, KAZUO KUSAKA (National Aerospace Laboratory, Kakuda, Japan), AKIRA TAKANO, HIDEYUKI KOBAYASHI (NASDA, Tokyo, Japan), MASAKUNI NAKAMURA, and SIGEYASU IIHARA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 89-94. refs

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When an altitude blowdown simulation test was conducted on the pressure-fed, blowdown, hydrazine/NTO apogee propulsion system selected for the ETS-VI to be launched by the H-II rocket in 1993, the chamber wall temperatures just upstream of the contraction section became higher at lower chamber pressures than those in the throat section. Experimental data on this anomalous and potentially critical phenomenon are presented. Efforts to avert or overcome this problem are addressed. C.D.

A92-53463

A NON-CATALYTIC HYDRAZINE ENGINE

RYOJIRO AKIBA (Institute of Space and Astronautical Science, Sagami-hara, Japan) and SEIYU KAYUTA (Institute of Space and Astronautical Science, Noshiro, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan,

May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 95-99. refs
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A new type of electrothermal hydrazine thruster is tested. An SiC semiconductor heater enables the thruster to operate without catalyst in two types of steady state modes: the resistojet mode and the bootstrap mode. An experimental system with 0.5 N thruster demonstrated steady operation in those modes. 1 kW heat input in resistojet mode enhanced c^* by 40 percent. Author

A92-53465 RECENT DEVELOPMENTS IN THE HYDRAZINE RELATED PROPULSION TECHNOLOGY IN NASDA

EIJI SOGAME, AKIRA TAKANO, SINGO MURAYAMA, HIDEYUKI KOBAYASHI (NASDA, Tokyo, Japan), MASATA MANAGO, MASAYUKI KAMEISHI, and EIJI YABUHARA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 107-112. refs
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During the past half decade, progress has been made by NASDA in the development of reaction control subsystems (RCS) for the H-II launch vehicle and satellites. There has been progress in the development of the liquid apogee propulsion system (LAPS) for the engineering test satellite ETS-VI, which uses a hydrazine/NTO bipropellant apogee engine for the first time in Japan. This paper introduces the outline of the reaction control subsystems for the H-II launch vehicle and the ETS-VI. It also introduces some major technological accomplishments in the development of propulsion system components. These components include propellant tanks, thrusters, valves, propellant filters, hydrazine decomposition catalyst, and anhydrous hydrazine. Author

A92-53466 DEVELOPMENT STATUS OF THE LIQUID APOGEE PROPULSION SYSTEM FOR ETS-VI

AKIRA TAKANO, HIDEYUKI KOBAYASHI, KOJI TERADA (NASDA, Tokyo, Japan), MASAKAZU SATO, KOICHI MIYOSHI, and YUICHI HAYASAKA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 113-118. refs
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A thermal problem was encountered during the design verification test of the apogee engine of the Liquid Apogee Propulsion System (LAPS) being developed for the engineering test satellite ETS-VI. The phenomenon was attributed to thermal decomposition of the hydrazine cooling film under conditions of low combustion pressure. A design modification of the propellant feed system based on a newly devised stepup blowdown scheme is described. C.D.

A92-53467 LOX/LH2 PROPULSION SYSTEM FOR EXPLORATION MISSION

TAKAHIRO ITO and TAKASHIGE MORI (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 119-124. refs
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A LOX/LH2 propulsion system used for injecting payloads into lunar transfer orbit or interplanetary orbit was studied. The propulsion system was a kind of Orbit Transfer Vehicle (OTV) propulsion system. The propulsion system and spacecraft would be launched into low earth parking orbit by the H-II rocket. After separation from the H-II rocket second stage, the propulsion system would inject the spacecraft into earth escape trajectory. A restart capability would be required for the propulsion system to inject the payload into lunar orbit. Author

A92-53468

TRANSIENT CHARACTERISTICS OF ROCKET TURBOPUMPS
TAKASHI SHIMURA and MITSUO WATANABE (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 125-131. refs
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Transient characteristics of high-speed, high-pressure cryogenic turbopumps for rocket engines were examined experimentally by starting and stopping several rocket turbopumps rapidly by gas turbine drive. Aspects of transient characteristics studied were instantaneous pump head coefficient and pump efficiency, cavitation growth in the inducer during rapid acceleration, effects of the starting mode related to the propulsion system mission, and transient behavior of a self-balancing type axial thrust balancing system. Based on the test results, the feasibility of definite starting modes for the LE-5 turbopump was confirmed and the self-balancing type axial thrust balancing system for the LE-7 LOX turbopump was completed. Author

A92-53469

TRANSIENT SIMULATION OF LOX/LH2 ROCKET ENGINE, LE-7

AKIO KANMURI, YOSHIO WAKAMATSU, TAKESHI KANDA (National Aerospace Laboratory, Kakuda, Japan), YOSHIHIRO TORII, RYUJI NAGAO, KAZUHISA KITAKURA, MASASHI OKADA, TAKAYUKI IMOTO, TAKASHI SAITO (NASDA, Tokyo, Japan), and KEIICHI HASEGAWA (Mitsubishi Heavy Industries, Ltd., Komaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 133-138. refs
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A start transient simulation calculation program was developed for the LE-7 LOX/LH2 rocket engine based on the quasi-steady model. Comparisons between simulation and test results are reported which show that simulation improvements and engine parameter adjustments are required. A brief description of the engine system is given. C.D.

A92-53470

LE-7 ENGINE DEVELOPMENT STATUS

MASAFUMI MIYAZAWA, EIJI SOGAME, YOSHIO YAMADA, AKIRA KONNO, YOSHIHIRO TORII (NASDA, Tokyo, Japan), KENJI KISHIMOTO, KEIJI HASEGAWA (Mitsubishi Heavy Industries, Ltd., Komaki, Japan), AKIRA OKAYASU (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and KENJIRO KAMIJO (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 139-144. refs
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Recent problems that have occurred during the development of the LE-7, the first stage main engine of the H-II launch vehicle, are discussed. A turbine crack was induced by the turbine drive gas wake and fuel pump cavitation occurred due to excessive throttle conditions at the start transient. The former problem was solved by adopting a solid turbine blade instead of a hollow one. The start sequence was refined to reduce excessive throttling. The resulting engine performance was 100 sec at 90 percent of designed nominal power. C.D.

A92-53473

EXPERIMENT ON A LOX-COOLED HYDROCARBON FUELED THRUST CHAMBER

H. TAMURA, N. YATSUYANAGI, H. SAKAMOTO, F. ONO, M. SASAKI, K. SATO, M. TAKAHASHI, A. KUMAKAWA (National Aerospace Laboratory, Kakuda, Japan), K. HIGASHINO, and K. SANO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol.

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1. Tokyo, AGNE Publishing, Inc., 1990, p. 159-166. refs
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The feasibility of regenerative LOX cooling with LOX/hydrocarbon propellant was experimentally investigated in a 7 kN rocket combustor. Supercritical LOX cooling tests with a LOX/hydrocarbon thrust chamber were successfully conducted without problems related to the cooling. The maximum heat flux at the throat was estimated at 59.5 MW/sq m. The rib temperature was in relatively good agreement with predicted values. C.D.

A92-53474

HEAT TRANSFER CHARACTERISTICS OF HIGH PRESSURE ROCKET COMBUSTORS WITH NI PLATED CHAMBER WALLS
AKINAGA KUMAKAWA, KAZUO SATO, MASAKI SASAKI, FUMIEI ONO, and MAMORU TAKAHASHI (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 167-174. refs
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The heat transfer characteristics of LOX/hydrogen, LOX/methane, and LOX/BH-1J propellants were studied using combustion tests in water-cooled calorimetric chambers with nickel-plated chamber walls. For LOX/hydrogen and LOX/methane, heat flux values measured at the throat section were 20-30 percent lower than values measured for bare copper chamber walls. It is inferred that microcracks in the nickel layer relaxed thermal stress and caused the unexpectedly high thermal resistance of the layer. There was no carbon deposition on the chamber wall when an injector with FOF impinging elements was used and hydrogen was added to the hydrocarbon fuels. When an injector with OFO impinging elements was used, carbon deposition on the nickel layer was observed at lower mixture ratios. C.D.

A92-53478

FIRING TEST OF SOLID MOTORS WITH PROPELLANT VOIDS AND SEPARATIONS

KATSUYA ITOH, TOSHIHARU TANEMURA, TSUTOMU FUJIWARA (National Aerospace Laboratory, Chofu, Japan), MORIO SHIMIZU, and NOBORU SANO (NASDA, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 201-208. refs
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This paper presents the effects of propellant voids, liner-propellant, and case-liner separations on the combustion behavior of scaled-down upper stage motors of NASDA. It was confirmed that the pressure trace changed as the trace change of the burning area due to defects and that the maximum chamber pressure could exceed the MEOP. The maximum chamber pressure, which was most important for catastrophic motor burst, increased by about 15 percent at the most in this test. However, this value can be dangerous for upper stage motors with lower safety factors. Author

A92-53483

BASIC DESIGN OF M-V SOLID ROCKET MOTORS

MASAHIRO KOHNO, HIROHIDE IKEDA (Institute of Space and Astronautical Science, Sagami-hara, Japan), HARUHIRO TANNO, and YUICHI YAMAMOTO (Nissan Motor Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 233-241. refs
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The basic design of M-V solid rocket motors is described. The three stages are discussed, as well as the case, propellant, nozzle, insulation, and igniter. C.D.

A92-53485

PARTICLE IMPINGEMENT IN SRM NOZZLES

HIROHIDE IKEDA (Institute of Space and Astronautical Science, Sagami-hara, Japan), HARUHIRO TANNO (Nissan Motor Co., Ltd., Tokyo, Japan), SHINICHIRO TOKUDOME, and MASAHIRO KOHNO (Institute of Space and Astronautical Science, Sagami-hara,

Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 249-254. refs
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It is experimentally shown that an improved two-phase flow program can well predict the alumina particle impingement location in small rocket motor nozzles as well as motor performance. The size distribution of particles in the nozzle flow is well characterized by a log-normal distribution. The program has achieved sufficient accuracy of prediction to be an effective nozzle contouring design tool. C.D.

A92-53488

EXPERIMENTAL INVESTIGATION ON SECONDARY COMBUSTION CHARACTERISTICS OF AIRBREATHING ROCKETS

TAKESHI MANO (Nissan Motor Co., Ltd., Tokyo, Japan), AKIHIRO EGUCHI, SUETSUGU SHINOHARA (NASDA, Tokyo, Japan), TAKAO ETOU, YUTAKA KANEKO (NASDA, Tsukuba, Japan), YUICHI YAMAMOTO (Nissan Motor Co., Ltd., Tokyo, Japan), and ICHIROU NAKAGAWA (Nissan Motor Co., Ltd., Kawagoe, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 267-274. refs
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Empirical correlations of the secondary combustion efficiency of the airbreathing rocket were derived. From the results of a series of experiments employing a connected pipe facility, the combustion efficiency was related to dominant parameters. The feasibility of the performance prediction by one-dimensional analysis was also discussed. The analysis was found to be applicable to the flow processes in the secondary combustor, which include two-stream mixing and combustion. Author

A92-53489

A STUDY OF AN AIR-BREATHING LIQUID ROCKET ENGINE

K. KAMIJO, M. NOSAKA, Y. SATO (National Aerospace Laboratory, Kakuda, Japan), and M. MATSUKI (Japan Institute of Technology, Minamisa-tama) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 275-279. refs
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Airbreathing liquid rocket engines are thought to show much higher efficiency than conventional pure rocket engines because they need not carry as much oxidizer as pure rockets. A system analysis of a cooled-air-cycle engine was carried out in order to determine whether such an engine system is feasible or not. In this engine the air scooped in is cooled by liquid hydrogen and sent to the combustion chamber by a compressor. Author

A92-53497

FUNDAMENTAL RESEARCHES OF PLASMAJETS AND ION SOURCES USING RESONANT-CAVITY MICROWAVE DISCHARGE

TOSHIKI YASUI (Osaka University, Toyonaka, Japan), MASAO ABUKU (Kawasaki Steel Co., Mizushima, Japan), HIROKAZU TAHARA, KEN-ICHI ONOE, and TAKAO YOSHIKAWA (Osaka University, Toyonaka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 329-340. refs
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A plasma source and an ion source were studied to develop high-performance thrusters in space. In the plasma source, the coupling efficiency had a maximum for cavity length variations at each ambient gas pressure. The peak characteristic became sharper with decreasing ambient gas pressure. The characteristic cavity lengths for discharge plasmas were longer than the theoretical resonant cavity length of the TM(011) mode without plasmas. The empty cavity had higher resonant performance, and resonant performance became low when discharge plasma was generated. The power dissipated in the cavity wall was less than

1.5 percent of the forward power with discharge plasmas. In the ion source, ion currents for the DCR coupling were larger than those for the EMP one. An ion production cost of 417 eV and a mass utilization of 73.3 percent were achieved for DCR coupling with a discharge tube length of 10 mm. Plasma densities of the order of $10 \times 10^{18}/\text{cm}^3$ and $T(e)$ s larger than 10 eV were created in the discharge chamber. C.D.

A92-53498

EXPERIMENTAL INVESTIGATION ON A HALL CURRENT ION THRUSTER

K. KOMURASAKI and Y. ARAKAWA (Tokyo, University, Japan)
IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 341-346. refs
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A Hall current ion thruster has been developed to investigate its thruster performance and acceleration process. Thrust was measured by mounting the thruster on a pendulum-type thrust stand and internal efficiencies such as propellant utilization, acceleration, and beam energy efficiencies were measured with an ion beam collector and an ion energy analyzer to examine their relations with the thruster performance. As the result, it was found that the product of such internal efficiencies gives a good approximation to the thrust efficiency directly obtained from thrust measurement and that the acceleration efficiency is the most important factor to be increased in improving thruster performance. Until now maximum thrust efficiency of 32 percent was obtained at a specific impulse of 1300 sec when xenon was used as the propellant. Author

A92-53499

THE MPD ARCJET THRUSTER SYSTEM FOR ELECTRIC PROPULSION EXPERIMENT ONBOARD SPACE FLYER UNIT

KYOICHIRO TOKI, YUKIO SHIMIZU, KYOICHI KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan), HIROSHI SUZUKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), and YOSHINORI KUNII (Mitsubishi Electric Corp., Kamakura, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 347-354. refs
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The Electric Propulsion Experiment (EPEX) will be tested in the Space Flyer Unit Mission One (SFU-1) as the first space-flown hydrazine MPD arcjet thruster system in the world. The development was continued after the breadboard model system endurance test in 1988 to start the engineering model fabrication/test. Presently the components of EPEX are scheduled to be integrated in a Payload Unit (PLU) box together with two other experiments in order to dedicate them to a system integration test following several environment tests. Author

A92-53500

THRUST PERFORMANCE OF 1 KW DC ARCJET THRUSTER

TETSUYA YAMADA (Tokyo, University, Japan), YUKIO SHIMIZU, KYOICHIRO TOKI, and KYOICHI KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 355-360. refs
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The dc arcjet thruster Sagami-I has been newly fabricated taking account of the results of the finite element thermal analysis. Thrust performance was parametrically studied for several different constrictor configurations with submillimeter diameters. The Sagami-I offered significant performance advantages over an older thruster: maximum specific impulse was 600 sec with 15 mg/s mass flow of $\text{N}_2 + 2\text{H}_2$ at 1.3 kW input power. The further reduction of a constrictor diameter was conducted to improve the specific impulse, and a limit was found. The effect of regenerative cooling was also estimated. Estimated propellant temperature up

to 1000 K in Sagami-I has demonstrated 40 sec higher specific impulse than that of the older type, in which only 600 K was attained. Author

A92-53501

LONG DURATION TESTS OF A LOW POWER ARCJET THRUSTER

HIROFUMI NAKAJIMA, YUZURU YASUDA, KEN-ICHI ONOE, TAKAO YOSHIKAWA (Osaka University, Toyonaka, Japan), MASAHIRO ISHII, and KAZUO UEMATSU (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 373-381. refs
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Endurance tests of a low power arcjet thruster have been carried out at a power level of about 0.6 kW using a hydrogen/nitrogen propellant mixture simulating fully decomposed hydrazine. In order to settle the problems of steady-state and startup erosion, the following life tests were conducted: (1) steady-state test over 50 hours of operation; (2) on-off (startup) test of 1000 cycles. The steady-state voltage increase of about 15 V signaled a recession of the cathode tip. The amounts of cathode and anode erosion were 1.1 mg and 3.5 mg, respectively. The anode and cathode erosion rates after startup test were 4.4 micro-g/cycle and 4.9 micro-g/cycle, respectively. The thruster characteristics after these testing were very similar to those observed before testing. No life limiting mechanisms were observed during the course of testing. Author

A92-53502

MICROWAVE ION ENGINE

YASUO HORIUCHI (NEC Corp., Yokohama, Japan), HITOSHI KUNINAKA, HIROAKI MIYOSHI (Institute of Space and Astronautical Science, Sagami-hara, Japan), HIROSHI IIDA (NEC Corp., Yokohama, Japan), and KYOICHI KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 383-388. refs
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A program to develop a microwave ion thruster is briefly discussed. The thruster is characterized by simultaneous production of main plasma and neutralizer plasma in a single oscillator. Successful experimental results realizing this new ion engine concept are reported. C.D.

A92-53503

NUMERICAL SIMULATION OF A LOW POWER DC ARCJET THRUSTER

AKIRA FUKATSU, RYUJI ISHII (Kyoto University, Japan), and KEN-ICHI TANAKA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 389-394. refs
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A low power dc arcjet thruster was studied numerically. The argon, helium and nitrogen gases were used as the propellant. The gasdynamic equations were solved by Osher and Chakravarthy's TVD scheme while the electric equations were solved by Jacobi-method. It was shown that the thrust and the specific impulse with discharge were several times as large as those without discharge and that the specific impulse for the helium gas was the largest among the three gases. It was also shown that the arc was concentrated in the vicinity of the cathode tip where the propellant temperature was sharply increased. These numerical results were found to be consistent with the previous experiments. From this, it can be concluded that the numerical simulation is a useful and powerful approach for the theoretical prediction of the arcjet thruster performance. Author

20 SPACECRAFT PROPULSION AND POWER

A92-53504

THRUST MEASUREMENTS OF AN ARCJET THRUSTER USING VARIOUS PROPELLANT GASES

KEN-ICHI TANAKA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan), AKIRA FUKATSU, and RYUJI ISHII (Kyoto University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 395-400. refs

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The influence of propellant species on the performance characteristics of a low power dc arcjet thruster was experimentally investigated. Three kinds of gases, argon, helium and nitrogen, were used as the propellants. The experimental result shows that the specific impulse of helium is the highest among the three gases. In terms of efficiency, argon is the best and nitrogen is the worst. The efficiency of nitrogen is extremely low, around 3-5 percent, compared with other two propellants. This low efficiency is caused by the dissociation of the gas taking place in the thruster and the large radiation loss from the thruster wall. As a consequence, it turned out that nitrogen was not appropriate for the propellant of the arcjet thruster. Author

A92-53505

A STUDY ON THE INTERACTION BETWEEN LASER BEAM AND GAS FLOW

MITSUTOSHI TSUJIOKA and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 401-406. refs

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A numerical analysis of the flowfield generated in a gas by a strong laser beam, which is of interest in laser propulsion, is reported. It is found that the beam can cause a shock wave followed by an absorption zone, i.e., simulated laser-supported detonation (LSD). Profiles of $T(e)$, $T(h)$, p , ρ , and number densities are almost flat behind the wave. The absorption zone is a thin layer where the number densities of electron and atom are of the same order. When a fully-absorbing LSD is formed, the thickness of the absorption zone can be defined as a distance in which the intensity of the incoming laser beam decreases by a factor of $1/e$. The thickness of the zone for the present LSD is about 70 microns. The detonation velocity is in reasonable agreement with Raizer's theoretical value after a fully-developed detonation. C.D.

A92-53506

CORRELATION BETWEEN FLOWFIELD AND THRUST PERFORMANCE OF MPD THRUSTER

TAKAYUKI NAKAYAMA, TATSUYA YOSHIDA, KYOICHIRO TOKI, and KYOICHI KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 407-412. refs

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Ion-neutral momentum coupling plays an important role of performance improvements of MPD (magnetoplasmadynamic) thruster in a low specific impulse range around 1000 sec. Quantitative imaging of MPD flowfields has been performed in order to confirm the ion-neutral momentum coupling phenomenon, and to enhance it. Such measurements of plasma properties were made by nonintrusive methods of magnetic sensitive film for current conduction pattern and far-infrared Mach-Zehnder interferometry for plasma density distribution. It was found that some characteristics of thrust performance was self-consistently explained by ion-neutral momentum coupling. Ion-neutral momentum coupling is emphasized in a high-neutral density region, i.e., the upstream region, and in a cathode jet observed in hydrogenous propellants. Author

A92-53507

THRUSTER PERFORMANCE AND ACCELERATION MECHANISMS OF A QUASI-STEADY MPD ARCJET WITH APPLIED MAGNETIC FIELDS

MASANORI SASAKI (NASDA, Kumage, Japan), HIROKAZU TAHARA, YOICHI KAGAYA, and TAKAO YOSHIKAWA (Osaka University, Toyonaka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 413-423. refs

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A quasi-steady magnetoplasmadynamic (MPD) arcjet with applied axial magnetic fields has been investigated at high specific impulse levels to improve the thruster performance and to understand the complex acceleration mechanisms with both a self-induced magnetic field and an applied one. Axial-field application was found to achieve higher thrust efficiencies at the same specific impulses and to achieve stable operations at higher specific impulses with less electrode erosion. Furthermore, the measured pressure characteristics near the electrodes and current density patterns showed that the total thrust increased in spite of a decrease in the electromagnetic pumping thrust and the small contribution of Hall acceleration. Thus, additional thrust components due to the axial field were expected to exist. Author

A92-53508

CHARACTERISTIC PARAMETER IN AN APPLIED-FIELD MAGNETOPLASMA DYNAMIC ARCJET

AKIHIRO SASOH (Nagoya University, Japan) and YOSHIHIRO ARAKAWA (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 425-430. refs

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Analytical and experimental studies have been conducted on the performance and thrust production mechanisms of an applied-field magnetoplasmadynamic (MPD) arcjet. Through a simple analysis using the plasma momentum equation and the generalized Ohm's law, the azimuthal current density and the specific impulse could be expressed as the function of a characteristic parameter. Thrust efficiency was found to be closely related to the characteristic parameter, thereby evaluating the applied field strength at which high thrust efficiency is obtained. Author

A92-53509

ENERGY BALANCE AND THRUSTER PERFORMANCE OF A QUASI-STEADY MPD THRUSTER IN CONTINUOUS OPERATIONAL TESTS

YOICHI KAGAYA, HIROKAZU TAHARA, and TAKAO YOSHIKAWA (Osaka University, Toyonaka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 431-438. refs

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The variation of thrust impulse during continual operation, the temperature distribution in the thruster head, and the energy flux in the exhaust plasma flow during repetitive firing of a quasi-steady magnetoplasmadynamic (MPD) thruster were measured. The energy flux was 60-70 percent of the electric input power and increased with increasing arc current. The energy rate of electrode loss at the anode decreased with increasing arc current. The anode temperature increased more rapidly than that of the cathode holder, and the time to steady state did not depend on the arc current level. Anode erosion was scarcely observed after operation at arc current of 6-10 kA in 20,000 shots. The thrust impulse decreased during continual operation and attained a steady state value of 65 percent of the initial value. C.D.

A92-53534

BASIC DESIGN OF EEC SYSTEMS FOR THE ISAS' NEW SATELLITE LAUNCHER M-V

MASAHIRO KOHNO, JUNJIRO ONODA, NAOYUKI WATANABE (Institute of Space and Astronautical Science, Sagami-hara, Japan), AKIRA OBATA, KOICHI YAMASHIRO, TAKAYUKI KITAMURA, and MASANORI HARADA (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 623-628. refs Copyright

Extendible nozzle exit cone (EEC) systems to be introduced to the upper stage motors of the new ISAS satellite launcher M-V are described. A newly developed, lightweight, and long-stroke double reverse helical spring extensor is examined. Individual attention is given to the EEC systems for the third and second stage motors, including graphical depictions. C.D.

A92-53563 AN EFFICIENT NUMERICAL TECHNIQUE FOR FLOWS IN AN MPD THRUSTER

OSAMU KIMURA and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 819-824. refs Copyright

An axisymmetric 3D analysis of an MPD accelerator has been developed in order to know various characteristics of the flowfield. A one-fluid model approximating a fully-ionized plasma gas as single component is considered. The term connected with the Hall effect in the generalized Ohm law is taken into account. The second-order TVD-upwind scheme is utilized for the purely gasdynamic flow, while the MacCormack-FCT scheme for the MHD flow. Because of the difference in the stability conditions between a first-order partial differential equation and a second-order partial differential equation, a technique called the SOSA (Switch-Over Successive Approximation) method is utilized for advancing the time. Author

A92-53565 FLOW MEASUREMENTS IN SCRAMJET INLETS

KOUICHIRO TANI, TAKESHI KANDA, TOMOYUKI KOMURO, ATSUO MURAKAMI, KENJI KUDOU, YOSHIO WAKAMATSU, GORO MASUYA, and NOBUO CHINZEI (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 831-836. refs Copyright

The experiments of scramjet inlets were made with varying sweep angle and contraction ratio. For each configuration of inlets, wall pressure, pilot pressure, and flow direction at the throat were measured. The flow patterns on the top and side walls were observed by surface flow visualization. Author

A92-53584 EXPERIMENTAL STUDIES OF ARC DISCHARGE ON NEGATIVELY BIASED SOLAR CELLS

HITOSHI KUNINAKA (Institute of Space and Astronautical Science, Sagami-hara, Japan) and DANIEL E. HASTINGS (MIT, Cambridge, MA) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 951-956. refs Copyright

The characteristics of arc discharge in solar cells are experimentally studied focusing on the dependence on capacitance. Specific treatment is given to the arc discharges that occur in solar cells that are biased negatively, so flight solar cells are biased in plasma. A current probe is employed to measure arc discharge in the solar cells within a multicusp plasma source as per Nakamura et al. (1977). The typical discharge-current profile is described, and the arc discharge is found to vary according to capacitance and bias with some mass degradation in the solar-cell samples. The experiment demonstrates that the magnitude of arc discharge can be controlled, and the effects of residual gas

adsorption on the arc discharge are found to be significant.

C.C.S.

A92-53586 ENGINEERING MODEL DESIGN OF ELECTRICAL POWER SUBSYSTEM FOR THE SPACE FLYER UNIT

AKIO USHIROKAWA, KEIJI TAKAHASHI (Institute of Space and Astronautical Science, Sagami-hara, Japan), NOBORU WAKASUGI, SHINOBU MATSUOKA (Institute of Unmanned Space Experiments Free Flyer, Tokyo, Japan), TAKEO KATSUKI, MITSUO HOMMA, and HIROKI KARASAWA (Toshiba Corp., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 965-976. Research supported by New Energy Development Organization. refs Copyright

The Space Flyer Unit (SFU) is an unmanned, automated, and reusable space platform. The development of the SFU has entered on its engineering model phase. Its electrical power subsystem has four batteries consisting of 19AH Ni-Cd cells to supply 1.4kW power to all subsystems and experiment payloads during eclipse. As a result of thermal analysis, it is predicted that the temperature of shunt dissipators rises up to 70 C and cools down to 40 C. Retrieval by the space transportation system is the highest priority mission of the SFU, so that the reliability and safety design should be the most important matter. In this paper an EM design of the electrical power subsystem from the point of view described above is presented. Author

A92-53606 ON THE METHOD TO EVALUATE THE FUEL OF BROADCASTING SATELLITE-2A (BS-2A) ON PRE-DEORBIT CONDITION

SHIGERU TERADA, KUNIYUKI YOKOBORI, and MICHIO SATO (Telecommunications Satellite Corporation of Japan, Kimitsu Satellite Control Center) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1113-1116. refs Copyright

Three methods used for the thruster fuel management of the Broadcasting Satellite 2A (BS-2a) are described: (1) the method based on estimating the fuel tank pressure and temperature, (2) the thruster firing time method, and (3) the method based on evaluating the maneuver achievement. The accuracy of the three methods for estimating the remaining fuel during the BS-2a mission lifetime is examined. Also presented are results on a comparison among these methods through the maneuver operations for deorbit of BS-2a. I.S.

A92-53627 THERMODYNAMIC PERFORMANCE OF SPACE STIRLING ENGINE - NALSEM 125

SACHIO OGIWARA, TSUTOMU FUJIWARA, KUNIHISA EGUCHI, and YOSHIHIRO NAKAMURA (National Aerospace Laboratory, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1261-1268. refs Copyright

The NAL of Japan has developed the SEM-125 free-piston research engine, which is configured with an integral linear alternator, with a view to solar dynamic spacecraft solar power system applications. An effort has been made to define the dynamic and thermodynamic characteristics of the engine by accurately measuring the time-varying movement of the piston-stroke on the basis of readings from a laser-optics gap sensor. These measurements are in qualitative agreement with the results of a simple coupling analysis that is based on a Schmidt-cycle model and a linear oscillation mode. O.C.

A92-53646 AKEBONO'S ELECTRICAL POWER SUBSYSTEM AND ITS FLIGHT RESULT

20 SPACECRAFT PROPULSION AND POWER

AKIO USHIROKAWA, KEIJI TAKAHASHI, MASAHIKO KOBATA (Institute of Space and Astronautical Science, Sagami-hara, Japan), RYUICHI CHIBA, KATSUAKI MATSUI (NEC Corp., Space Development Div., Yokohama, Japan), and MASAKAZU KUDOH (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1411-1419. Copyright

Japan's ISAS launched its 12th scientific-payloads satellite, Akebono, on February 22, 1989; the spacecraft has since then been conducting experiments to clarify the acceleration mechanism of auroral particles. Akebono's electrical power system uses solar array panels that generate more than 270 W at the end of their service life, as well as a 19 amp/hr battery that has as of this writing been operating for over 1.2 years. It is anticipated on the basis of these data that the requisite service life will be achieved.

O.C.

A92-53658

SYSTEM TEST OF ENGINEERING TEST SATELLITE VI (ETS-VI) ELECTRICAL MODEL

HIROSHI KITAHARA, CHIKARA HARADA (NASDA, Spacecraft Dept., Tokyo, Japan), TADAYOSHI AKAEDA, HUMIO ITOH, and YASUO TANAKA (Toshiba Corp., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1497-1499.

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NASDA's ETS-VI is intended to verify the design of a satellite bus system that meets the requirements of next-generation broadcasting and communications satellites; it will also demonstrate various associated satellite communications subsystems. An account is presently given of the electrical system configuration and integration work thus far achieved. System testing will proceed from structure integration to bus subsystem and communications experimental equipment integration and testing, to the retesting of components transferred onto the mission module from the dummy module.

O.C.

A92-53767

SPACE EXPERIMENT OF HIGH VOLTAGE SOLAR ARRAY ONBOARD SFU

H. KUNINAKA, K. TAKASHI, A. USHIROKAWA, and K. KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2231-2236. refs

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The High Voltage Solar Array (HVSA) experiment to be carried into orbit aboard Japan's Space Flyer Unit in 1994 will demonstrate the safe and stable operation of such a power source in LEO, as well as the novel capability of optimal bus voltage power generation through changes in solar-cell series-parallel connections. The HVSA encompasses a solar array module and a 'versatile power control unit' (VPCU) that can call for the generation of up to 280 V in 70-V increments. The VCPU can also count plasma-induced discharges and measure their duration.

O.C.

A92-53771

DEVELOPMENT OF THE SOLAR STIRLING ENGINE ALTERNATOR FOR SPACE EXPERIMENTS

MASAFUMI NOGAWA, TAKANORI HAMAJIMA, HIROKI ISHIKAWA, YUTAKA MOMOSE (Aisin Seiki Co., Ltd., Second Research and Development Center, Nishio, Japan), and NOBUHIRO TANATSUGU (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2255-2260. refs

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The IAS-200 prototype Stirling engine alternator is a subscale, but otherwise identical version of the flight design that is to be

carried by the Japanese Space Flyer Unit. This free-piston Stirling engine uses He as the working gas and employs a displacer and two power pistons that are arranged in opposing configuration in order to minimize vibration. This linear alternator furnishes high efficiency over a wide operating range, and has successfully operated for over 200 hrs.

O.C.

N92-10056# National Aerospace Lab., Tokyo (Japan).

EXPERIMENTAL INVESTIGATION OF A 12 CM DIAMETER KAUFMAN XENON ION THRUSTER

KATSUHIRO MIYAZAKI, YUKIO HAYAKAWA, and SHOJI KITAMURA Mar. 1991 19 p In JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1099) Avail: CASI HC A03/MF A01

An experimental study was performed on discharge performance improvement of an 12 cm diameter Kaufman-type xenon ion thruster to study the effects of discharge chamber configurations on discharge performance. Various discharge chamber configurations were constructed by changing the shapes and heights of the pole piece, the positions of the main hollow cathode, the cathode baffle diameters, and the discharge chamber magnets. These parameters were selected because they are relatively easy to change and have a large influence on discharge performance. Thruster operation tests were then conducted using each of these experimental configurations. Results revealed that a straight cylinder type pole piece provided lower ion production costs and higher discharge voltages than an inside brim pole piece, although differences are only slight. Larger diameter cathode baffles gave higher discharge voltages, with the effects of baffle diameter changes on the characteristics of ion production cost with respect to propellant utilization efficiency, being larger in the brim pole piece than in the straight cylinder one. A 30 mm high brim pole piece gave the best discharge performance. Discharge chamber configurations appropriate for operational use ion thrusters were selected based on these results.

Author

N92-11127# National Aerospace Lab., Tokyo (Japan).

CALIBRATION OF TURBINE FLOWMETERS FOR STORABLE BIPROPELLANT ENGINES

YUKIO KURODA, MAKOTO TADANO, MASAHIRO SATO, KAZUO KASAKA, HIROSHI MIYAJIMA, RYUICHI NAGASHIMA, and MASAKAZU SATO Jan. 1991 22 p In JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1091) Avail: CASI HC A03/MF A01

Propellant flow rate measurement is one of the most important factors in rocket engine evaluations. In the development of the apogee engine for the engineering test satellite- IV(ETS-IV), the mass flow rate measurement uncertainty requirement for the propellants is less than ± 0.25 percent, thus ensuring that the overall uncertainty of the measured specific impulse is less than 1 percent. The engine's propulsion system design adopted a complete blowdown system, thus it is important to ensure that the measurement accuracy for a wide range of flow rates, i.e., from about 30-120 percent of the minimum flow rate. To achieve this uncertainty level, an in-place/end-to-end turbine flowmeter calibration system was developed. The calibrations were conducted with actual propellants under pressures and temperatures similar to those in firing tests, thereby reducing errors caused by variations in fluid physical properties and densities. The characteristics and accuracies of the flow calibration system are described, as well as the method and results of the flow calibration using both hydrazine N2H4 and nitrogen tetroxide (NTO). The uncertainty of the calibration factors, K-factors (pulse per unit volume), was generally estimated to be within ± 0.25 percent of the nominal flow rate (185 cc/sec for NTO and 265 cc/sec for N2H4).

Author

N92-13170# Kobe Univ. (Japan). Dept. of Electrical Engineering.

A NOVEL SOFT-SWITCHING SINEWAVE PWM CONVERSION CIRCUIT AND SYSTEM WITH HIGH-FREQUENCY LINK

H. YONEMORI, K. MUNETO, A. CHIBANI, and M. NAKAOKA /*in* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 107-112 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

A newly improved sinewave CVCF Power Conversion conditioning System (PCS) based upon a high frequency (HF) isolated AC link cycloconversion circuit using softswitching phase shifted pulse width modulation and instantaneous voltage regulation schemes is presented. This advanced circuit topology of voltage clamped quasi-resonant (QR) switch, which comprises two cascaded power conversion stages operating under the principle of Zero Voltage Switching (ZVS), is introduced in order to minimize switching losses, device stresses, electromagnetic interference noise, and remove a complicated HFAC snubber. A considerable improvement in power density output performance and power conversion efficiency is achieved employing a HF link soft switched cycloconversion concept. Its working principle is described including control processing strategy. A voltage clamped QR sinewave PSM HFAC inverter is analyzed under load dependent current source model and its approximate circuit design approach is discussed theoretically. The computer aided simulating and experimental results are illustrated and evaluated for UPS and utility lineinterfaced power supply systems. ESA

N92-13177# Kobe Univ. (Japan). Dept. of Electrical Engineering.

ZERO-VOLTAGE SOFT-SWITCHED PWM HIGH-FREQUENCY AC-LINK DC-DC CONVERTERS INCORPORATING SATURABLE REACTOR-ASSISTED CAPACITIVE LOSSLESS SNUBBER TOPOLOGY FOR DISTRIBUTED POWER SUPPLY SYSTEMS

S. NAGAI (Kobe Univ. (Japan).), T. YAMAMOTO (Kobe Univ. (Japan).), M. NAKAOKA (Kobe Univ. (Japan).), and S. HAMADA (Sansha Electric Mfg. Co. Ltd., Japan) /*in* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 165-171 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

A new constant frequency soft switching phase shifted mode Pulse Width Modulated (PWM) DC-DC power converter topology suitable for high power applications, which incorporates two phase half bridge high frequency inverter and saturable reactor in series with rectifier, is described. The newly proposed high power density converter with high frequency isolation link is capable of accomplishing an efficient and reliable Zero Voltage Switching (ZVS) under a considerable variation range from no load to full load and a wide voltage regulation range. Its steady state operating characteristics are evaluated and discussed through computer aided simulation which are required for an optimum converter design and experimental results. ESA

N92-13187# National Space Development Agency, Ibaraki (Japan).

DESIGN OF THE JAPANESE EXPERIMENT MODULE ELECTRICAL POWER SYSTEM

M. KOMATSU (National Space Development Agency, Tokyo (Japan).), T. GOHNAI (Mitsubishi Electric Corp., Tokyo (Japan).), and S. KITAKATA (Mitsubishi Electric Corp., Tokyo, Japan) /*in* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 233-238 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The design of the Japanese Experiment Module's (JEM) electric power system is discussed including the key design goals of electrical performance, power distribution system, power management, and control. Tradeoff studies were conducted for many of the more important JEM electric power system design decisions. The results of the tradeoff studies should be reflected in the first development model of the Power Distribution Unit (PDU). ESA

N92-13196# Furukawa Electric Co. Ltd., Tokyo (Japan). Space and Aeronautical Div.

LIFE CHARACTERISTICS OF NI-CD BATTERY CELLS FOR SCIENTIFIC SATELLITES

Y. ISHIKAWA (Furukawa Electric Co. Ltd., Tokyo (Japan).), K. FUJITA (Furukawa Electric Co. Ltd., Tokyo (Japan).), M. HIROSE (Furukawa Electric Co. Ltd., Tokyo (Japan).), M. KOUBATA (Nippon Electric Co. Ltd. (Japan).), M. KUDOH (Nippon Electric Co. Ltd. (Japan).), K. MATSUI (Furukawa Electric Co. Ltd., Tokyo (Japan).), K. MURATA, K. SAITOH, M. TAJIMA, K. TAKAHASHI (Tokyo Univ., Japan) et al. /*in* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 297-302 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

Nickel cadmium battery cells have been used as a secondary power source for scientific satellites in Japan. Battery cells which have a capacity of 2 to 19 Ah were mounted and worked well in orbit during the mission life of each satellite. The ground life test and flight data of the Prototype Model (PM) battery cells and onboard cells with 19 Ah capacity for the 11th scientific satellite GINGA are described. It is confirmed that the NiCd PM battery cells for GINGA have life characteristics of more than 25,000 charge/discharge cycles at 25 percent of depth of discharge. Therefore, it can be presumed that the PM cells have characteristics providing more than 45 years of life in low Earth orbit. ESA

N92-13200# Nippon Telegraph and Telephone Public Corp., Tokyo (Japan). Applied Electronics Lab.

A HIGH-EFFICIENCY AND LIGHT-WEIGHT TWT POWER SUPPLY FOR A COMMUNICATIONS SATELLITE

TAKASHI YAMASHITA, SATOSHI OHTSU, KATSUHIKO YAMAMOTO, and TOSHIYUKI SUGIURA /*in* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 323-328 Aug. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The weight of Traveling Wave Tube (TWT) power supply can be reduced by increasing the switching frequency. It is however difficult to raise the switching frequency since there is much switching loss caused by current charging and discharging to/from the stray capacitance of a high voltage transformer. A new method for designing high voltage transformers and choke coils to reduce power loss caused by transformer stray capacitance is described. With the method, the switching frequency of a TWT power supply can be raised to 200 kHz from 20 kHz without increasing power loss. Furthermore, a heater inverter is simplified and surface mount technology is applied to a control circuit and the heater inverter. As a result, a newly developed TWT power supply weighs about 30 percent of the conventional power supply. ESA

N92-13214# Electrotechnical Lab., Ibaraki (Japan).

EXPERIMENTAL AND DESIGN STUDY ON ALKALI METAL THERMOELECTRIC CONVERTER FOR AEROSPACE POWER

T. MASUDA, A. NEGISHI, K. TANAKA, T. HONDA, and T. FUJII /*in* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells p 431-435 Aug. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The experimental results of the series connected Alkali Metal Thermoelectric Converter (AMTEC) cells and the theoretical considerations about internal resistances are reported. For the series cells, the open voltage of 2.73 V, the short circuit current of 20 A and the maximum power of 9.24 W at 1077 K were obtained. This power was about 60 percent of the sum power of each single cell. This power decrease was due to the large resistance of the current collecting bus bar. In a design study, numerical data which seemed to be achievable in near future were assumed. The calculated output power, total cell number, reactor thermal output, radiator output, efficiency and total mass were 300 kW, 3415 cells, 1032 kWt, 732 kWt, 29 percent, and 8059 kg, respectively. ESA

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N92-13225# Tokyo Univ., Sagami-hara (Japan). Inst. of Space and Astronautical Science.

INP SOLAR CELLS FOR SCIENTIFIC SATELLITE APPLICATIONS

K. TAKAHASHI (Nippon Telegraph and Telephone Public Corp., Tokai (Japan).), M. KOHBATA (Nippon Electric Co. Ltd., Yokohama (Japan).), A. OHNISHI (Nippon Electric Co. Ltd., Yokohama (Japan).), T. HAYASHI (Nippon Electric Co. Ltd., Yokohama (Japan).), A. USHIKAWA, M. YAMAGUCHI, S. IKEGAMI, K. HASHIMOTO, H. ARAI, T. ORII (Nippon Electric Co. Ltd., Yokohama, Japan) et al. *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 501-506 Aug. 1991

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

High efficiency homojunction InP solar cells were developed. To evaluate and qualify them for space applications, various environmental tests were conducted on the ground. Additionally, the InP cells were installed as a radiation degradation characteristic instrument onto the EXOS-D scientific satellite and as a power source for the lunar orbiter on board Muses-A. Large decreases in the short circuit current and the open circuit voltage on the cells on board the EXOS-D satellite were found to be due to lower energy proton irradiation. Output power of the solar array for the lunar orbiter was at predicted levels until the separation from the 13th satellite to place the orbiter in orbit around the Moon. ESA

N92-13229# Tsukuba Space Center (Japan).

INVESTIGATION OF SILICON SOLAR CELL AND MODULE REVERSE CHARACTERISTICS

M. UESUGI (National Space Development Agency, Ibaraki (Japan).), T. NOGUCHI (National Space Development Agency, Ibaraki (Japan).), Y. TONOMURA (Tsukuba Space Center, Ibaragi (Japan).), T. HISAMATSU (Tsukuba Space Center, Ibaragi (Japan).), T. SAGA (Tsukuba Space Center, Ibaragi (Japan).), T. MATSUTANI (Sharp Corp., Nara (Japan).), and A. SUZUKI (Sharp Corp., Nara, Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 523-528 Aug. 1991

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Investigations into the reverse characteristics of ultrathin silicon solar cells and modules for space application are reported. Based on the acquired data, a computer simulation program for evaluation of reverse characteristics of the shadowed cell and module was proposed. The results of experiments suggested the possibility that breakdown occurred at relative low reverse bias voltage (about 20 V) due to raising of the cell temperature on the partially shadowed module in the space environment. ESA

N92-13243# National Space Development Agency, Ibaraki (Japan).

PRODUCTION AND IMPROVEMENT OF 50 MICRON AND 100 MICRON THIN SILICON SOLAR CELLS FOR SPACE USE

S. MATSUDA (National Space Development Agency, Ibaraki (Japan).), T. NOGUCHI (National Space Development Agency, Ibaraki (Japan).), M. UESUGI (National Space Development Agency, Ibaraki (Japan).), T. SAGA (Sharp Corp., Nara (Japan).), Y. TONOMURA (Sharp Corp., Nara (Japan).), K. KAMIMURA (Sharp Corp., Nara (Japan).), H. YOSHIOKA (Sharp Corp., Nara (Japan).), T. MATSUTANI (Sharp Corp., Nara (Japan).), and A. SUZUKI (Sharp Corp., Nara, Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 609-613 Aug. 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Fifty micron and 100 micron silicon solar cells (phase 1 cells) were produced for eight Japanese satellite programs. The production of thin solar cells showed high mechanical yields and tight distributions of power output. The photolithographic mask and lift off technique to form fine gridlines was introduced to realize high short circuit current. The improved 50 micron and 100 micron cells (phase 2 cells) showed 14.3 percent and 14.8 percent efficiencies respectively. More efficient thin silicon solar cells are

under study. The target efficiencies of 50 micron and 100 micron Back Surface Field Reflecting (BSFR) cells are 16 percent and 17 percent respectively. Efficiencies up to 16 percent on 100 micron cells were obtained. ESA

N92-13248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ENHANCED EOS PHOTOVOLTAIC POWER SYSTEM CAPABILITY WITH INP SOLAR CELLS

SHEILA G. BAILEY, IRVING WEINBERG, and DENNIS J. FLOOD *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 641-645 Aug. 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The Earth Observing System (EOS), which is part of the International Mission to Planet Earth, is NASA's main contribution to the Global Change Research Program which opens a new era in international cooperation to study the Earth's environment. Five large platforms are to be launched into polar orbit, two by NASA, two by ESA, and one by the Japanese. In such an orbit the radiation resistance of indium phosphide solar cells combined with the potential of utilizing five micron cell structures yields an increase of 10 percent in the payload capability. If further combined with the advanced photovoltaic solar array the payload savings approaches 12 percent. ESA

N92-13263# Nippon Electric Co. Ltd., Tokyo (Japan).

SFU SOLAR ARRAY DEVELOPMENT TEST

Y. SHIBAYAMA (Tokyo Univ. (Japan).), K. HAMA (Tokyo Univ. (Japan).), H. IRIKADO (Tokyo Univ. (Japan).), T. OKUDAIRA (Institute for Unmanned Space Experiments Free Flyer, Tokyo (Japan).), H. TAKE, A. USHIKAWA, M. NATORI, K. TAKAHASHI, N. WAKASUGI, and T. ANZAI (Institute for Unmanned Space Experiments Free Flyer, Tokyo, Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 735-740 Aug. 1991 Sponsored by New Energy and Industrial Technology Development Organization

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Space Flyer Unit (SFU) solar array is a 3 kW, flexible fold out, and retractable solar array on board a Japanese free flyer scheduled to be launched at the end of 1993. Extensive development tests were successfully completed on a SFU solar array engineering model to verify the design requirements. Manufacturing and assembly of the solar array protoflight models have been completed, and acceptance testing will start in May 1991. The development test results for the SFU solar array are outlined. ESA

N92-13264# Nippon Electric Co. Ltd. (Japan).

THE SOLAR ARRAY OF ASTRO-D SPACECRAFT

Y. OKADA (Nippon Electric Co. Ltd. (Japan).), J. TAKAHASHI (Tokyo Univ. (Japan).), Y. SHIBAYAMA (Tokyo Univ. (Japan).), M. TAJIMA, J. ONODA, and M. KOHBATA (Tokyo Univ., Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators p 741-746 Aug. 1991

Copyright Avail: CASI HC A02/MF A03; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The 15th scientific satellite, ASTRO-D, is being developed. The ASTRO-D X-ray observatory spacecraft, will be launched by a Mu booster in February, 1993. The electrical power for the ASTRO-D is supplied by two deployable solar array wings. The structural and technical design of the ASTRO-D solar array and the test results of an engineering model are outlined. ESA

N92-18240# National Aerospace Lab., Tokyo (Japan).

SWEPT FREQUENCY TYPE OF ULTRASONIC INSPECTION METHOD FOR LINER-PROPELLANT SEPARATIONS OF SOLID MOTORS

MORIO SHIMIZU May 1991 58 p *In* JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1107) Avail: CASI HC A04/MF A01

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A swept frequency type ultrasonic inspection method is used for inspecting not only case liner separations, but also liner propellant separations of solid motors, with its successful application to the H-I upper stage motors also being discussed. This new method has been in development at the National Aerospace Lab (NAL) since 1968, and is based on using the one dimensional quarter wavelength resonance principle to determine the liner thickness under both free and fixed end face boundary condition, being considered to be the liner's line propellant separation boundary condition. Since the motor cases have curved (spherical/cylindrical) surfaces, several curved contact surface probes were developed. This method was subsequently applied to test successfully both the apogee and third stage motor of the H-I rocket during manufacturing and also at the launch site. This inspection has contributed to successful launching of the H-I rocket since the first launching in August 1987, and will be applied to the Solid Rocket Booster (SRB) of the H-II rocket. Author

N92-20922# Tokyo Univ., Sagami-hara (Japan).
ATTITUDE CONTROL SYSTEM OF THE RETRIEVAL TYPE ROCKET S-520

ICHIRO NAKATANI (Tokyo Univ. (Japan).), JUNICHIRO KAWAGUCHI (Tokyo Univ. (Japan).), RITUO HASEGAWA (Tokyo Univ. (Japan).), MASARU ABE (Tokyo Univ. (Japan).), and KAZUHIKO ASHINA (Mitubishi Precision Co. Ltd., Japan) *In its* Proceedings of the Symposium on Mechanics for Space Flight 1990 p 47-52 Mar. 1991
 Avail: CASI HC A02/MF A02

The retrieval type sounding rocket S-520 was developed by the Institute of Space and Astronautical Science to make possible the recovery (and eventual reuse) of onboard attitude control electronics. The attitude control system and flight results are described. Author

N92-21537*# Lindley (Charles A.), Tarzana, CA.
INTERNATIONAL AEROSPACEPLANE EFFORTS
 CHARLES A. LINDLEY *In* NASA. Lewis Research Center, Rocket-Based Combined-Cycle (RBCC) Propulsion Technology Workshop, Tutorial Session 8 p 1992
 Avail: CASI HC A02/MF A03

Although the U.S. began the first reusable space booster effort in the late 1950's, it is no longer an exclusive field. All of the technologically advanced nations, and several groups of nations, have one or more reusable booster efforts in progress. A listing of the entries in the field is presented. The list is somewhat misleading, because it includes both fully reusable and partially reusable boosters, both manned and unmanned, and both flight test and operational proposals. Additionally, not all of the projects are funded, and only a few of the projects will survive. The most likely candidates are the following: France/ESA, Germany/ESA, Great Britain/ESA/USSR, USSR(past), and Japan. A discussion of the preceding projects is provided. Author

N92-24756# Tsukuba Space Center, Ibaragi (Japan).
OPERATIONAL STRATEGIES FOR LIQUID APOGEE PROPULSION SYSTEM

M. HIROTA (Tsukuba Space Center, Ibaragi (Japan).), MIKIO SAWABE (Tsukuba Space Center, Ibaragi (Japan).), HIRUKO AOKI (Fujitsu Social Systems Engineering Ltd., Tokyo (Japan).), and T. SHIMIZU (Fujitsu Ltd., Tokyo, Japan) *In* ESA, Spacecraft Flight Dynamics p 279-284 Dec. 1991
 Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The plan to launch an Engineering Test Satellite, the ETS-6, in 1993 is reported. The operation involves a three stage apogee maneuver that will move the ETS-6 from an elliptical transfer orbit to a near synchronous orbit. The move is powered by liquid fuel. The apogee maneuver is split into three stages, in order to compensate for magnitude and direction of thrust error. An important aspect of the operation is that apogee engine firing execution commands will be sent from the station. The final orbit achieved by the steps should put the ETS-6 into the optical acquisition range defined by a combination of deviations in satellite

longitude: apogee height and orbital plane. Injection strategies for nominal and backup cases, plus the optimal thrust direction and burn times calculated considering time restrictions and mission constraints, are discussed. ESA

N92-27430# National Aerospace Lab., Kakuda (Japan). Research Center.

STRUCTURAL ANALYSIS OF THERMAL FATIGUE FAILURES ON ROCKET COMBUSTION CHAMBERS BY THE FINITE ELEMENT METHOD

TOMOYUKI HASHIMOTO Jul. 1991 23 p *In* JAPANESE; ENGLISH summary
 (ISSN 0389-4010)
 (NAL-TR-1117; JTN-92-80384; DE92-562500) Avail: CASI HC A03/MF A01

Accurately estimating the thermal stress and strain levels in rocket combustion chambers is an important factor for increasing their safety and reliability. At the NAL, two thermal fatigue failures have occurred in water cooled combustion chambers. This paper examines the cause of the failures and chamber deformations using an inelastic structural analysis incorporating the Finite Element Method (FEM). Both the analytical crack initiation life at low cycle fatigue conditions and analytical deformation determined using a crack initiation model agreed with observed results obtained by a Scanning Electron Microscope (SEM) and with the eye. Another analysis indicates that modifying the cooling channel design would increase the crack initiation life. It was also shown that FEM structural analysis is an effective method for estimating thermal stress and strain levels in rocket combustion chambers. Author (NASDA)

N92-33790# Nissan Motor Co. Ltd., Tokyo (Japan).

FLY-BACK BOOSTERS [FURAI BAKKU BUSUTA]

TAKASHI MAKINO and SEIJI MATSUDA *In* NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 13 p 17 Jul. 1991 *In* JAPANESE
 Avail: CASI HC A03/MF A10

The first system review on rocket systems composed of fly-back booster and expendable upper-stage rockets which are capable of launching a payload of 30 tons into low earth orbit is conducted. Three types of winged reusable fly-back booster systems are reviewed on the following premises: (1) payload launch capability of 30 tons; (2) start of operation in the years 2000 to 2010; (3) two-staged vertically launched vehicles; and (4) the core will be a LH2/LOX two-stage launch vehicle with LE-7A rocket engines. 2nd-stage fundamental features, booster stage aerodynamic design, aerodynamic performance estimates, booster stage sizing, orbit analysis, and system trade-off of the fly-back boosters are reviewed. Fly-back booster launch vehicle flight sequence, 2nd-stage features, configuration and characteristics of three types of rocket system, and fly-back booster orbit condition histories are outlined. Author (NASDA)

N92-33791# Kawasaki Heavy Industries Ltd., Kobe (Japan). Aerospace Group.

CONCEPTUAL STUDY ON VERTICALLY LAUNCHED FLY-BACK BOOSTERS [SUICHOKU UCHIAGE HOUSHIKI FURAI BAKKU BUSUTA NO GAINEN KENTOU]

KOUICHI YONEMOTO and TAKASHI MUGITANI *In* NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 23 p 17 Jul. 1991 *In* JAPANESE
 Avail: CASI HC A03/MF A10

A conceptual study is conducted of fly-back boosters as the proposed candidates for future transportation systems which can be realized in the near future. System design requirements such as policy and scope of design study are reviewed. Conceptual design of the body such as the design flow and design conditions, optimization of performance sharing between fly-back boosters and upper-stage rockets, body configurations, weight estimates and weight balance of the body, trade-off of candidate optimized configurations, and flight profiles is conducted. Baselines and candidates of configuration, required performance, weights of

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engines for cruising, and dimensions of the body are presented. Results of body weight analyses, and flight profiles are also presented. Author (NASDA)

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CHEMISTRY AND MATERIALS (GENERAL)

A92-17859#

CURRENT STATUS OF R&D IN JAPAN ON MATERIALS FOR SPACE PLANES

MEGUMI SUNAKAWA (Yokohama National University, Japan) and AKIRA SAKAMOTO (R&D Institute of Metals and Composites for Future Industries, Tokyo, Japan) AIAA, International Aerospace Planes Conference, 3rd, Orlando, FL, Dec. 3-5, 1991. 8 p. refs (AIAA PAPER 91-5096) Copyright

A trend analysis is presented of material technologies required to develop technologies for space planes with attention to meeting stated objectives of material performance. The objectives include high specific modulus and strength, environmental resistance, and low cost. Materials are considered in terms of their applications to airframe structures and engines as well as the specific conditions of the severe environments. Some materials are reviewed that are under research in response to the requirements identified and include titanium aluminides, Ti-Al matrix composites, niobium aluminides, and high-performance C/C composites. Functionally gradient materials (FGMs) are proposed to handle thermally severe environments. FGMs combine ceramics and metallic components in microstructurally controlled formations to address adjacent but different thermal-expansion coefficients. C.C.S.

A92-18634

INTERNATIONAL CONFERENCE ON ADVANCED MATERIALS MECHANICAL PROPERTIES '90 (ICAMP '90), UTSUNOMIYA, JAPAN, AUG. 6-9, 1990, SELECTED PAPERS

TAKEO YOKOBORI, ED. (Teikyo University, Utsunomiya, Japan) and TERUO KISHI, ED. (Tokyo, University, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, 294 p. For individual items see A92-18635 to A92-18650. Copyright

Topics discussed include the high-temperature mechanical properties of advanced materials, advanced composites, the nonelastic deformation of ceramiclike materials, the impact and thermal-shock behavior, and the time and cyclic effects. Papers are presented on new computing systems and their impact on structural and fractured mechanics calculations, the creep crack growth in high-temperature ductile materials, and the dynamic fracture toughness in ceramics and ceramic-matrix composites. Attention is also given to the interface microstructure and strength of SiC/SiC joint brazed with Cu-Ti alloys, high-temperature deformation and grain growth in fine-grained zirconia, quasi-brittle behavior of ceramics and its relevance for thermal shock, and oblique impact damage by spherical particles onto Si₃N₄. Other papers are on joining zirconia to metals using Zr-Cu alloy, the application of ultrasound to joining ceramics with metals, and alumina coating of austenitic stainless steel by sol-gel process. I.S.

A92-20779

COMPUTER SIMULATION OF DOSE EFFECTS ON COMPOSITION PROFILES UNDER ION IMPLANTATION

Y. MIYAGAWA, M. IKEYAMA, K. SAITO, G. MASSOURAS, and S. MIYAGAWA (Government Industrial Research Institute, Nagoya, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Dec. 15, 1991, p. 7289-7294. refs

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A Monte Carlo code is described which has been developed to simulate the dose dependence of concentration profiles and

sputtering yields during ion implantation. By using this code, dose-dependent changes in the composition of 3000-A-thick aluminum and 2500-A-thick zirconium due to 50-keV nitrogen ion implantation with fluences of 5×10^{16} - 1×10^{18} ions/sq cm have been calculated. In the case of Zr, good agreement is found between the calculated and experimental composition profiles. V.L.

A92-21146

CHARGE-DISCHARGE CHARACTERISTICS OF POLYPYRROLE FILMS CONTAINING INCORPORATED ANTHRAQUINONE-1-SULFONATE

HIROSHI YONEYAMA, YORIKO II, and SUSUMU KUWABATA (Osaka University, Suita, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, Jan. 1992, p. 28-32. refs Copyright

A promising strategy for increasing the energy density of polypyrrole films used as an active material in the secondary batteries is proposed. It is shown that anthraquinone-1-sulfonate incorporated in polypyrrole films (PPy/AQ-SO₃(-)) as a fixed dopant displays redox activities involving two electrons, resulting in an enhancement of the quantity of electricity generated in redox reactions of the PPy films. The highest energy density reached in a PPy/AQ-SO₃(-) film was 150 Ah/l, which is more than twice as large as that of polypyrrole films containing electrochemically inactive anions such as naphthalene-1-sulfonate or ClO₄(-). I.S.

A92-21500

QUANTUM CONVERSION AND IMAGE DETECTION BY A BACTERIORHODOPSIN-BASED ARTIFICIAL PHOTORECEPTOR

TSUTOMU MIYASAKA, KOICHI KOYAMA, and ISAMU ITOH (Fuji Photo Film Co., Ltd., Ashigara Research Laboratories, Japan) Science (ISSN 0036-8075), vol. 255, Jan. 17, 1992, p. 342-344. refs

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A thin film (50 to 500 angstroms thick) comprising fragments of bacteriorhodopsin (bR)-containing purple membrane was formed on an SnO₂ conductive electrode by the Langmuir-Blodgett method. The film was put into contact with a thin, aqueous electrolyte gel to construct an electrochemical sandwich-type photocell with a junction structure SnO₂/bR/electrolyte/Au electrode. Under visible light irradiation, the bR-based photocell produced an efficient rectified photocurrent that proved to have unique differential responsivity to light intensity, which is characteristic of in vivo biological photoreceptors. An artificial photoreceptor comprising a pixel network of the bR photocell was fabricated in an attempt to study image-detecting and processing abilities of bR. Author

A92-22038

QUANTUM WIRE AND DOT FORMATION BY CHEMICAL VAPOR DEPOSITION AND MOLECULAR LAYER DEPOSITION OF ONE-DIMENSIONAL CONJUGATED POLYMER

TETSUZO YOSHIMURA, SATOSHI TATSUURA, WATARU SOTOYAMA, AZUMA MATSUURA, and TOMOAKI HAYANO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 20, 1992, p. 268-270. refs

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Using the reaction between two types of molecules, I (TPA) and II (PPDA), (DDE), (DDS), (DDM), quantum wires and quantum dots are fabricated by chemical vapor deposition. In the TPA/PPDA film, an exciton absorption peak occurs near 500 nm, indicating that long conjugated chains (quantum wire) are formed. In TPA/DDE, TPA/DDS, and TPA/DDM films, which have quantum dots consisting of three benzene rings separated by barriers of -O-, -S-, and -CH₂- bonds, blue shifts of the absorption band occur due to an electron confinement. Molecular layer deposition of the TPA/PPDA film is also demonstrated. Author

A92-25498

WHY AROMATIC COMPOUNDS ARE STABLE

JUN-ICHI AIHARA (Shizuoka University, Japan) Scientific

American (ISSN 0036-8733), vol. 266, March 1992, p. 62-68. refs

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The high stability of molecules containing benzenelike rings is explained mathematically by means of the theory of topological resonance energy. The theory combines the study of geometric shapes with the quantum principles of electron orbitals and energy levels. The molecular structure of benzene is shown to be alternating single and double bonds, and similar bonds in chain bonding are studied to determine whether they have equivalent binding energies. Molecular orbit theory is employed to develop the compound polynomial, and a hypothetical structure is developed in which the pi electrons do not circulate in a ring. It is shown that the molecular stability of aromatic compounds can be expressed in numerical and geometric terms. The IR spectrum of the Orion nebula is shown to diagrammatically resemble the light scattered from automobile soot. The theory can be applied to the study of fullerenes and is of general interest to the development of fuels, synthetic fibers, resins, dyes, and combustion techniques. C.C.S.

A92-27223

WETTING OF HOT-PRESSED BETA-SiC BY LIQUID ALUMINUM

KENJI SATO (Tokyo Metropolitan Industrial Technological Center, Japan) and HIDEO NAKAE (Waseda University, Tokyo, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Dec. 1991, p. 841-846. In Japanese. refs

Wetting of hot-pressed beta-SiC by liquid aluminum was studied by sessile drop method under 1×10^{-5} Pa in He-3 vol pct H₂ and in a vacuum of 1×10^{-3} Pa. The contact angle (theta) varies during holding at constant temperature. In the wetting in He-H₂, four stages are observed: (1) decrease in theta immediately after dropping, (2) initial stationary wetting with constant theta, (3) spreading of aluminum on SiC substrate with decrease in theta and (4) stationary wetting with constant theta. When the interfacial reaction occurs between SiC and the drop, two interfacial energies decrease, and hence theta decreases at the third stage. In the wetting in a vacuum, three stages are observed: (1-prime) initial stationary wetting, (2-prime) decrement of theta, and (3-prime) stationary wetting. The reaction occurs at the stage 1-prime, while the decrement of theta at the stage 2-prime, is caused by evaporation of aluminum; theta decreases with increasing temperature, and a significantly abrupt decrement of theta is found at a certain temperature in each atmosphere. This phenomenon is caused by the interfacial reaction between SiC and aluminum. In particular, this temperature in a vacuum is lower than that in He-H₂ due to evaporation of aluminum. Author

A92-28813

HIGH-RESOLUTION MICROSCOPY OF THE SILICON CARBIDE/ALUMINUM CARBIDE INTERFACE

TOYOHICO YANO, SATOSHI KATO, and TAKAYOSHI ISEKI (Tokyo Institute of Technology, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, March 1992, p. 580-586. Research supported by MOESC. refs

Copyright

The atomic arrangement of an SiC/Al brazed joint has been investigated with HREM, which confirms the formation of the Al₄C₃ reaction product on the SiC according to a topotactic relationship. An exact correspondence is established between the 13th atomic column of SiC and the 12th of Al₄C₃ along the 1 -1 0 0 line direction. An additional, transition phase is formed between the SiC and Al₄C₃; the misfit between the SiC and Al₄C₃ lattice was accommodated 'semicoherently', via interfacial dislocations and the atomic arrangement of the transition phase. A correspondence was observed between the 10th layer of SiC and the 9th layer of Al₄C₃, across a complex structure up to several tetrahedra in width. O.C.

A92-32024

EVALUATION OF THERMAL SHOCK FRACTURE OF PLASMA-SPRAYED THERMAL BARRIER COATINGS BY MEANS OF A LASER TECHNIQUE

TOSHIYUKI HASHIDA, KENJI WAKANA, and HIDEAKI TAKAHASHI Japan Society of Mechanical Engineers, Transactions A (ISSN 0387-5008), vol. 56, Sept. 1990, p. 1952-1956. In Japanese. refs

Results of laser heating thermal shock tests conducted on plasma-sprayed thermal barrier coatings are presented. The coatings tested were single-layer ZrO₂ (stabilized with eight percent Y₂O₃) and functionally gradient materials consisting of multilayers with varying mixture ratios of ZrO₂ and Ni-based superalloy (NiCrAlY). Two different fracture patterns were noted that led to coating spallation or exposure of the substrate: one being the extensive coalescence of vertical cracks, and the second being the delamination growth. The oxidation at the ceramic-metal interface demonstrates control of the thermal cycling life of the ceramic coating. R.E.P.

A92-38038

PENTAGONS, HEPTAGONS AND NEGATIVE CURVATURE IN GRAPHITE MICROTUBULE GROWTH

SUMIO IJIMA, TOSHINARI ICHIHASHI (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan), and YOSHINORI ANDO (Meijo University, Nagoya, Japan) Nature (ISSN 0028-0836), vol. 356, no. 6372, April 30, 1992, p. 776-778. refs

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TEM images of a fullerene growth morphology are presented in which conelike growth is transformed into cylindrical growth by the incorporation of a defect that induces negative curvature. It is suggested that the defect in the hexagonal network responsible for negative curvature may be a single heptagonal ring. The effects of pentagons and heptagons on the growth morphologies of these tubules are discussed, as are the constraints on the number of pentagonal defects imposed by tube closure. C.D.

A92-38092

ENCAPSULATION OF A SCANDIUM TRIMER IN C82

HISANORI SHINOHARA, HIROYASU SATO (Mie University, Tsu, Japan), MASATO OHKOHCHI, YOSHINORI ANDO (Meijo University, Nagoya, Japan), TAKESHI KODAMA, TADAMASA SHIDA, TATSUHIKA KATO (Kyoto University, Japan), and YAHACHI SAITO (Mie University, Tsu, Japan) Nature (ISSN 0028-0836), vol. 357, no. 6373, May 7, 1992, p. 52-54. refs

Copyright

The preparation of scandium-containing C₈₂ species, including an encapsulated scandium trimer, Sc₃ inside C₈₂, is described. Mass spectrometry and ESR spectroscopy provide evidence that the Sc₃ trimer is indeed trapped within the carbon cage. C.D.

A92-38215

TRENDS OF ADVANCED MATERIALS

AKIRA SAKAMOTO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 115-124. In Japanese.

Advanced composite materials are discussed, with particular attention given to CFRPs, metal matrix composites, ceramic matrix composites, and carbon-carbon composites. Research developments on Al-Li alloy, advanced alloys with controlled crystalline structure, rapidly solidified power metallurgy, and engineering ceramics are examined. Y.P.Q.

A92-38777

NMR CHARACTERIZATION OF ISOMERS OF C78, C82 AND C84 FULLERENES

KOICHI KIKUCHI, NOBUO NAKAHARA, TOMONARI WAKABAYASHI, SHINZO SUZUKI, HARUO SHIROMARU, YOKO MIYAKE, KAZUYA SAITO, ISAO IKEMOTO, MASATSUNE KAINOSHO, and YOHJI ACHIBA (Tokyo Metropolitan University,

23 CHEMISTRY AND MATERIALS (GENERAL)

Hachioji, Japan) *Nature* (ISSN 0028-0836), vol. 357, no. 6374, May 14, 1992, p. 142-145. Research supported by MOESC. refs Copyright

C-13 NMR is used here to determine the structures of some principal isomers of C₇₈, C₈₂, and C₈₄. A third isomer of C₇₈ not reported by Diederich et al. (1991) is found. Characterization of the structures of these larger fullerenes should provide new understanding of the factors determining the stability of hollow carbon clusters. C.D.

A92-39633

RECENT PROGRESS OF FUNCTIONALLY GRADIENT MATERIALS IN JAPAN

M. KOIZUMI (Ryukoku University, Otsu, Japan) *Ceramic Engineering and Science Proceedings* (ISSN 0196-6219), vol. 13, no. 7-8, July-Aug. 1992, p. 333-347. refs Copyright

Functionally-gradient materials (FGMs) can combine ceramics and metals to yield materials of microscopically inhomogeneous character with continuous compositional changes that result in continuous property changes. Attention is given to FGM compositions of SiC/C, partially stabilized zirconia/304 stainless steel, Ni-base alloy/ZrO₂, TiB₂/Cu, and TiC/Ni, which have thus far been investigated in Japan. FGMs are of interest not only to designers of highly refractory aerospace structures but also to designers of prospective optical and electronics systems. O.C.

A92-39640

FUNCTIONALLY GRADIENT MATERIAL OF THE SYSTEM NI-MGO, NI-NIO, NI-Si₃N₄ OR AL-ALN, BY PRESSURELESS SINTERING

KOJI ATARASHIYA, KAZUYA KUROKAWA, TADAO NAGAI (Hokkaido University, Sapporo, Japan), and MASAHIRO UDA (Nisshin Steel Co., Ltd., Ichikawa, Japan) *Ceramic Engineering and Science Proceedings* (ISSN 0196-6219), vol. 13, no. 7-8, July-Aug. 1992, p. 400-407. refs Copyright

Generally speaking, the preparation of FGM-blocks, especially in the metal-nitride systems, by the method of powder metallurgy needs an extremely high temperature and high pressure. But, in this work using a ductile nickel metal powder or an ultrafine particle, the FGM-blocks were easily prepared using a powder metallurgy at a lower temperature. A mixture of a metallic powder and a non-metallic powder whose contents were gradually changed was pressed in a steel die under pressure of 20-32 MPa. This green compacts were heated at 900-1573 K in controlled atmosphere under null pressure. The FGM-blocks prepared by this method were characterized by their properties and were used in joinings. The joinings of metal/FGM/ceramics, metal/FGM and ceramics/FGM were completely accomplished at 900-1573 K. Author

A92-40534

Si₃N₄, SiC, Al₂O₃/Cu BONDING WITH UTILIZING MO METALLIZATION OF CERAMICS BY MEANS OF ION BEAM DYNAMIC MIXING

MASAMICHI MATSUURA, NAKAYA CHIDA (Ulvac Japan, Ltd., Tsukuba), and HARUKO FUJINUMA (Ulvac Japan, Ltd., Electronics and Ionic Equipment Div., Chigasaki) *Japan Institute of Metals, Journal* (ISSN 0021-4876), vol. 56, no. 3, March 1992, p. 308-314. In Japanese. refs Copyright

Molybdenum metallization of Si₃N₄, SiC, and Al₂O₃ substrates for metal-ceramic bonding was performed using an ion-beam dynamic-mixing method, in which a cylindrical ceramic substrate 5 mm in diameter and 5 mm in length was irradiated simultaneously with an 8.0 x 10 to the -15 J (50 keV), 1-2 x 10 to the 5 microA/m-sq Ti(+) ion beam and a Mo molecular beam at a substrate temperature of 573 K. The substrate metallized with a Mo film 2-5 microns in thickness was bonded to a copper pin 2.5 mm in diameter with an amorphous Cu-9Ni-4Sn-7P solder at 973 K in a depressurized Ar-gas atmosphere. Compared to the sputtering

technique, the dynamic mixing resulted in a joint of superior tensile strength and allowed greater versatility in selection of the chemical type of ceramic substrate. S.A.V.

A92-41631

CUBIC SILICON CLUSTER

KAZUAKI FURUKAWA, MASAIE FUJINO, and NOBUO MATSUMOTO (NTT, Basic Research Laboratories, Musashino, Japan) *Applied Physics Letters* (ISSN 0003-6951), vol. 60, no. 22, June 1, 1992, p. 2744, 2745. refs Copyright

A cubic silicon cluster having eight bonds each terminated by a tert-butyl substituent, tert-butyloctasilacubane (TBOSC), is studied. TBOSC was formed and isolated by chemical procedures. The optical properties of TBOSC were measured in comparison with those of bulk silicon. TBOSC is purple and its absorption edge is observed at 650 nm (1.9 eV) at room temperature. This absorption edge is 0.8 eV larger than that of bulk silicon. It also shows photoluminescence extending to 850 nm at 77 K although bulk silicon shows no photoluminescence. Author

A92-42818

IN SITU FT-IR DETECTION OF STABLE COMPOUNDS IN THE MICROWAVE PLASMAS OF VARIOUS SOURCE GASES FOR VAPOR PHASE DIAMOND GROWTH

T. MITOMO, T. OHTA, E. KONDOH, K. OHTSUKA, and Y. HABU (Kawasaki Steel Corp., New Materials Research Center, Japan) *IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 213-218. refs Copyright*

Product distributions in the microwave plasmas of various source gases for vapor phase diamond growth were investigated by using in situ Fourier transform infrared spectroscopy. The gas mixtures of C₂H₂+H₂, C₂H₄+H₂, CH₃OH+H₂, C₂H₅OH+H₂, CCl₄+H₂ and CO+H₂, controlled at 0.5-8.0 percent carbonaceous compounds in source gases, were introduced into the plasma region. The detected carbonaceous compounds were CH₄, C₂H₂ and C₂H₄. Among these compounds, CH₄ and C₂H₂ were observed in all source gases, whereas C₂H₄ was detected only at higher concentrations of the carbonaceous compounds in the source gases. CO was produced from source molecules containing oxygen atoms. The source molecules of CH₃OH, C₂H₅OH and CCl₄ disappeared in the microwave plasma. The products distributions in the plasmas of CH₄+H₂, C₂H₂+H₂ and C₂H₄+H₂ were very similar. This implies that an equilibrium among CH₄, C₂H₂, C₂H₄, H₂, H, electrons and various radicals is kept in the hydrogen excess plasma. Moreover, it was found that the addition of O₂ to the CH₄+H₂ plasma reduced the concentrations of CH₄ and C₂H₂ in the plasma. Author

A92-44874

REACTIVE WETTING OF CERAMICS BY LIQUID METALS

HIDEO NAKAE, HIDETOSHI FUJII (Waseda University, Tokyo, Japan), and KENJI SATO (Tokyo Metropolitan Industrial and Technological Center, Japan) *JIM, Materials Transactions* (ISSN 0916-1821), vol. 33, no. 4, April 1992, p. 400-406. refs Copyright

The phenomenon of reactive wetting of ceramics by liquid metals was examined on the basis of experimental results reported by Nakae et al. (1989, 1991), Yoshimi et al. (1990), Fujii and Nakae (1990), and Fujii et al. (1991) from measurement of wetting with the meniscograph and sessile drop methods. In particular, wetting of Cu by Hg, of graphite by Al and Al-Si, and of MgO and AlN by Al were investigated. All experiments gave similar wetting curves with time. Four phases, I, II, III, and IV, were found in a wetting system accompanied by interfacial reactions. These phases are described with respect to the wetting situation and the characteristics. I.S.

23 CHEMISTRY AND MATERIALS (GENERAL)

A92-47201

THERMOMECHANICAL BEHAVIOR OF THERMAL-STRESS RELIEF TYPE OF FUNCTIONALLY GRADIENT MATERIAL EVALUATED BY DIFFERENTIAL TEMPERATURE HEATING USING H₂/O₂ COMBUSTION FLAME

AKIRA KAWASAKI, ATSUSHI HIBINO, and RYUZO WATANABE (Tohoku University, Sendai, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 4, April 1992, p. 472-480. In Japanese. refs

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A burner heating test for the thermomechanical evaluation of functionally gradient material in the laboratory is described. A temperature gradient is obtained by heating the ceramic side with a burner frame and cooling the metal side with water flow. The damage at the specimen surface is monitored with a microscope. A vertical crack formation at the ceramic surface is observed during the cooling cycle. The test temperature for the first crack formation is defined as a thermal barrier performance value for the test sample. It is found that the crack formation temperature is almost constant for the various samples and heating conditions, which indicates a strong dependency of the thermal barrier property on the material species. The crack formation mechanism is discussed on the basis of a thermal stress analysis using a finite element method. Author

A92-47378

INTERFACE REACTIONS BETWEEN CVD-SiC FIBERS AND MOLTEN AL-TI, AL-ZR ALLOYS

TADASHI ARIGA, YASUO MIYAMOTO (Tokai University, Hiratsuka, Japan), and KATSUMASA HOSOI (Victor Company of Japan, Ltd., Tokyo) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 4, April 1992, p. 198-204. In Japanese. refs

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Interface reactions between CVD-SiC fibers and liquid aluminum containing Ti or Zr were investigated in the temperature range 973-1273 K. The reaction time ranged from 0.9 to 7.2 ks. The additional elements Ti and Zr were selected because they are active in aluminum. The addition of Ti or Zr accelerated the interface reaction between fibers and the molten matrix. Ti was more effective than Zr to accelerate the interface reaction. Author

A92-47760

HEAT-RESISTANT STRUCTURES IN THE AEROSPACE PLANE AND FUNCTIONAL GRADIENT MATERIALS

YASUO TADA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 461, 1992, p. 315-325. In Japanese. refs

Heat-resistant structural materials for hypersonic aircraft and spaceplanes are presented. The ambient temperature of the space plane engines and its heat transfer distribution are illustrated. The concept of functional gradient materials (FGM) is addressed. Y.P.Q.

A92-53518

AN IMPROVEMENT IN DESIGN ACCURACY OF FUNCTIONALLY GRADIENT MATERIAL FOR SPACE PLANE APPLICATIONS

TOHRU HIRANO, TOMOHIKO YAMADA, JUNICHI TERAOKI (Daikin Industries, Ltd., CAE Center, Sakai, Japan), AKINAGA KUMAKAWA, MASAYUKI NIINO (National Aerospace Laboratory, Kakuda, Japan), and KENJI WAKASHIMA (Tokyo Institute of Technology, Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 501-506. Research supported by Science and Technology Agency. refs

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In this paper, improvements to functionally gradient material (FGM) an advanced thermal barrier material for the space plane, are reported. These improvements include: extension of thermal stress analysis procedure for FGM, the introduction of a constitutive theory for multiphase composites and mixture results for material

strength regarding porosity, and improvements in the inverse design procedure of FGM. Experimental results of high-temperature gradient tests verify improvement in design accuracy. C.D.

A92-53567

THERMAL FATIGUE OF FUNCTIONALLY GRADIENT MATERIALS WITH HIGH TEMPERATURE DIFFERENCE

SATOSHI NAGATA, NAOHITO ADACHI, AKIRA SAKAMOTO (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), AKINAGA KUMAKAWA, MASAKI SASAKI, MASAYUKI NIINO (National Aerospace Laboratory, Kakuda, Japan), and SHUHEI MAEDA (Sumitomo Heavy Industries, Ltd., Hiratsuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 843-850. refs

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A method for evaluating the thermal fatigue behavior of functionally gradient materials (FGM) is proposed whereby thermal fatigue is determined from the change of thermal conductivity under thermal cycling. The method has been tested on both conventional plasma-sprayed PSZ specimens and several FGM materials. The results demonstrate that FGM specimens have longer thermal fatigue lives than the conventional material, which makes these materials attractive for aerospace heat shield applications. V.L.

A92-53577

THERMAL PROTECTION SYSTEMS FOR REUSABLE SPACE VEHICLES

HIDEHIKO MITSUMA, TOMOYUKI KOBAYASHI, HIROBUMI TAMURA, and MOTOHIRO ATSUMI (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 909-914. refs

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The status of research and development of advanced thermal protection systems (TPS) for an unmanned reusable space return vehicle, i.e., H-II Orbiting Plane (HOPE) to be launched in the late 1990s by NASDA, is presented. Candidate TPS for HOPE are titanium multiwall TPS for temperatures less than 550 C, carbon-carbon TPS for 550-1300 C, and ceramic TPS, especially on antenna areas. TPS development focuses on establishing the basic configurations which have high reliability and maintainability. Design and manufacturing considerations of each TPS are outlined. P.D.

A92-56002

CURRENT STATUS OF R&D ON MATERIALS FOR SUPER/HYPersonic TRANSPORTS

MEGUMI SUNAKAWA (Yokohama National University, Japan) and AKIRA SAKAMOTO (R&D Institute of Metals and Composites for Future Industries, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 2-11. In Japanese. refs

The current status of R&D on materials for super/hypersonic transports and space planes is outlined. The state of the art in materials, materials characteristics, and materials techniques are addressed and advances that need to be made are considered. Emphasis is given to the availability of lightweight and heat-resistant materials such as high-temperature polymer matrix composites, metal matrix composites, intermetallic compounds, ceramic matrix composites, and carbon-carbon composites. C.D.

COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

A92-10140**THE CHARACTERISTICS OF 3-D ORTHOGONAL WOVEN FABRIC REINFORCED COMPOSITES 3-D (CF/EP)**

T. HIROKAWA, J. YASUDA, Y. IWASAKI (Shikibo, Ltd., Research and Development Dept., Shiga, Japan), and Y. NOGUCHI (National Aerospace Laboratory, Tokyo, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 1. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 151-160. refs

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The tensile, compressive, flexural fatigue and impact behavior of two types of composites reinforced by two types of 3D orthogonal woven fabric with different ratio of fiber content, were compared to a 2D laminated composite. It was found that an increase of fiber content in the thickness direction of 3D reinforcement was effective on compressive and flexural fatigue behavior. Regarding tensile behavior, there was not much difference between two types of 3D composite, but the tensile strength and elongation at rupture of 3D composites were improved by linear alignment of fiber in each direction, respectively. It can be also seen that both of the 3D composites tend to limit the damage area more effectively than the 2D laminated composite. Author

A92-10186**HIGHLY DAMAGE TOLERANT PREPREG SYSTEM BASED ON SINGLE PHASE MATRIX RESIN**

M. SUGIMORI, T. MURATA, S. HAYASHI, T. KATO, K. TANAKA, K. GOTO, T. HATTORI, and H. TADA (Mitsubishi Rayon Co., Ltd., Product Development Laboratory, Nagoya, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 1. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 863-871. refs

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A new highly damage-tolerant prepreg system, MR60P/X1055, for primary structural applications of commercial aircraft was developed on the basis of a single-phase resin system. A study of the mechanical properties of this system demonstrated that the system had excellent impact resistance and hot/wet properties, as well as excellent processability. A summary of mechanical properties of a Pyrofil MR60P/X1055 laminate is presented. I.S.

A92-10243**COMPRESSION NONLINEARITY OF PITCH-BASED HIGH MODULUS CARBON FIBER REINFORCED EPOXY COMPOSITES AND STRUCTURAL RESPONSES**

KENJI KUBOMURA and NOBUYUKI TSUJI (Nippon Steel Corp., Chemical Research Laboratory, Kawasaki, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1664-1674. refs

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Longitudinal compression behaviors of unidirectional composites are studied to understand the role of fiber-compressive property in the deformation and failure by systematically varying reinforcing high-modulus carbon-fiber tensile modulus. They deform with a strong softening with the increasing compressive strain and trace back the loading path when the load is removed. The intensity of softening is correlated to the fiber tensile modulus, and possible softening mechanisms are discussed in conjunction with fiber and matrix properties. Further, it is investigated how the nonlinear stress-strain relation affects the stress and strain distributions and

deformation when plates fabricated from these fibers are tested by the three-point bending test. Author

A92-10244**BEARING STRENGTH OF PAN-BASED AND PITCH-BASED CARBON FIBER COMPOSITE MATERIALS**

HIRONORI MAIKUMA and KENJI KUBOMURA (Nippon Steel Corp., Chemical Research Laboratory, Kawasaki, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1675-1685. refs

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Bearing strengths for four pitch-based and two PAN-based carbon-fiber composite materials of (0 deg/+/-45 deg/90 deg) 3S laminate were characterized. It was found that the full bearing strengths were developed when the edge distance ratios were equal to or greater than 3.0 and the side distance ratios were equal to or greater than 4.0. As the fiber strain to failure became larger and also as the longitudinal compressive strength of unidirectional composites became higher, the bearing strength became higher. No correlation was apparent between tensile strength of the fiber and bearing strength. It was also found that the smaller resistance index (RI) value gave the smaller bearing strength, and the large (RI) value gave the higher one. Author

A92-10248**MOLDING PROCESSABILITY OF NEWLY DEVELOPED UNIQUE THERMOPLASTIC PREPREGS AND MECHANICAL PROPERTIES OF THEIR COMPOSITES**

KEIICHI HARAGUCHI, KEIZO HOSOI, MAKOTO FUJII, EIJI SATO, and KEISAKI NAGASAWA (Asahi Chemical Industry Co., Ltd., Moriyama, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1720-1731. refs

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WIP, a new thermoplastic prepreg made of thermoplastic fiber and unidirectional carbon fiber or carbon-fiber woven fabric, is presented. WIP exhibits fine handling properties such as good drapability and easy cutting. It requires lower pressure and shorter time for molding than a conventional cowoven-type prepreg because of interlacing at the individual filament level, and the WIP composite exhibits good mechanical properties compared with a conventional cowoven-type composite because of its excellent fiber distribution. C.A.B.

A92-10267**FABRICATION OF SECONDARILY FORMABLE LONG FIBER REINFORCED METALS**

H. ASANUMA, M. HIROHASHI, T. KIKUCHI, and H. KITAGAWA (Chiba University, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 2055-2066. Research supported by MOESC and Hattori-Houkokai Foundation. refs

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An attempt was made to improve a fabrication method of the long-fiber-reinforced aluminum composite which has fiber-matrix interface layers to enable its secondary forming. By replacing the zinc insert foil to form the interface layers and adhere matrix plates with arc-spraying of zinc onto matrix plates, formation of uniform interface layers became possible. The interface layers obtained abruptly softened at the temperature just beyond the melting point of zinc and were even strengthened by heat treatment. Adhesion strength of matrix aluminum plates doubled and the multilayer composite of a higher volume fraction came to be easily fabricated. The multilayer composite could be successfully bent without fiber breakages and bucklings at the softening temperature of the interface layers. Author

A92-10279**MECHANICAL PROPERTIES OF MESO-CARBON MICROBEADS/CARBON FIBER COMPOSITES**

YOSHITERU NAKAGAWA, TAKAYUKI AZUMA, and SATORU NAKATANI (Osaka Gas Co., Ltd., Research and Development Center, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 2. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 2210-2222. refs

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The present study examines new meso-carbon microbead/carbon fiber composites. After mesocarbon microbeads (MCs) and 0.5-mm (S) and (F) stabilized carbon fibers surface-treated with coal tar were mixed and the mixture was molded at room temperature, the MC/carbon composite was graphitized at 2000 C. Adding 30 wt pct (S) to MC produced a composite with one-tenth the wear of commercially available carbon/carbon composites. It was found that (S) not only bonded to MC better than (F), but was stronger and denser. In contrast to this, (F) was superior to (S) when it came to seizure load. It is argued that MC/carbon composite production methods using an MC matrix are simpler and far more cost-effective than conventional methods. P.D.

A92-11984**THERMAL PROPERTIES OF CHEMICAL VAPOUR-DEPOSITION SiC-C NANOCOMPOSITES**

YUCONG WANG, MAKOTO SASAKI, and TOSHIO HIRAI (Tohoku University, Sendai, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 26, Oct. 15, 1991, p. 5495-5501. refs (Contract MOESC-63850149; MOESC-63750730)

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The present study examines the relationship between the thermal properties and the microstructure of CVD SiC-C nanocomposites, covering the entire composition range from SiC to C, after measuring thermal conductivity and thermal expansion. Deposition temperatures of 1673 and 1773 K and total gas pressure of 40 kPa. The thermal conductivity of CVD SiC-C nanocomposites decreased as the C content increased. For the deposits containing 24.3 to 71 mol pct C prepared at 1773 K, some parts of the C phase formed a layered structure having its plane parallel to the deposition surface. This arrangement reduced the thermal conductivity in the direction perpendicular to the deposition surface to a much lower value. The CVD C and CVD C-SiC containing less than 1.5 mol pct SiC showed strong anisotropic thermal expansion. The thermal expansion of CVD SiC-C nanocomposites having a C content up to about 70 mol pct was isotropic and nearly equal to that of CVD SiC. P.D.

A92-12041**VERY HIGH STRAIN-RATE SUPERPLASTICITY IN A PARTICULATE Si3N4/6061 ALUMINUM COMPOSITE**

M. MABUCHI, T. IMAI, K. KUBO (Government Industrial Research Institute, Nagoya, Japan), K. HIGASHI, Y. OKADA, and S. TANIMURA (Osaka Prefecture, University, Sakai, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 25, Nov. 1991, p. 2517-2522. refs

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The study deals with constant true strain tests carried out over a wide strain-rate range from 0.0001 to 100/s at an optimum superplasticity temperature of 833 K in air. The tensile axis is selected to be parallel to an extrusion direction for all tests, and the flow stress for each strain rate is determined at a fixed small true strain. The microstructural morphology of composites is discussed as well as the flow stress behavior and elongation. A high-strain-rate superplasticity is found in an as-extruded 20-vol-pct Si3N4/6061 aluminum composite; the maximum elongation of 620 pct is recorded at a strain rate of 2/s. V.T.

A92-13047**THE FRACTURE TOUGHNESS FOR FIRST MATRIX CRACKING OF A UNIDIRECTIONALLY REINFORCED CARBON/CARBON COMPOSITE MATERIAL**

TATSUYA MIYAJIMA and MOTOTSUGI SAKAI (Toyohashi University of Technology, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 6, Nov. 1991, p. 2312-2317. Research supported by Engineering Research Association for High Performance Ceramics. refs (Contract MOESC-03453073) Copyright

The fracture toughness for first matrix cracking of a uniaxially reinforced C-fiber/C-matrix composite is investigated using a modified controlled surface flaw method. The theoretical models for first matrix cracking of brittle matrix composites including the stress intensity and the potential energy approaches are reviewed in the light of the experimental results. The sharing of the applied load between the reinforcing fibers and the brittle matrix along with extensive crack front debonding enhance the fracture toughness for first matrix cracking. Author

A92-13440**INFLUENCE OF PROCESSING PARAMETERS ON THE THRESHOLD PRESSURE OF INFILTRATION IN ALUMINA FIBER/ALUMINUM COMPOSITE SYSTEM**

HARUYUKI NAKANISHI (Daihatsu Motor Co., Ltd., Shiga, Japan), YOSHIKI TSUNEKAWA, MASAHIRO OKUMIYA, and ITARU NIIMI (Toyota Technological Institute, Nagoya, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Sept. 1991, p. 576-581. In Japanese. refs

The effects of the pressurizing rate, the pressure holding time at the maximum applied pressure and molten-metal temperature, and the matrix temperature on the threshold pressure of infiltration into fiber preforms was investigated for a beta-alumina-fiber/molten aluminum composite system. The pressurizing rate in infiltration was varied from 0.20 kPa/sec to 16 kPa/sec, and pressure holding time at the maximum applied pressure was varied between 100 and 300 sec. It was found that the pressurizing rate and the pressure holding time at the maximum applied pressure did not affect the threshold pressure for alumina fiber preforms with quasi-planar random arrangement. However, increasing the temperature of molten aluminum from 943 K to 1163 K resulted in a decrease of threshold pressure from 259 kPa to 162 kPa. I.S.

A92-15131**WHISKER REINFORCED COMPOSITES PREPARED FROM WET BALLMILLED ALUMINUM POWDER**

J. SHIMIZU, J. KUSUI, A. TANAKA, and O. IWAOKA (Toyo Aluminium, Yao, Japan) IN: Metal and ceramic matrix composites: Processing, modeling and mechanical behavior; Proceedings of the International Conference, Anaheim, CA, Feb. 19-22, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 31-38. refs Copyright

Whisker-reinforced aluminum-alloy composites were consolidated by vacuum hot pressing followed by hot extrusion. To get a uniform distribution of whiskers, it is necessary to use powders having a small particle size. Wet ballmilled aluminum powders were found to be effective in achieving a uniform distribution of whiskers, resulting in enhanced mechanical properties of the extruded composites. The effects of wet ballmilling and consolidation conditions on the tensile strength of composites have been investigated. The results show that the tensile strength of Al alloy 6061 reinforced by 20 vol pct of SiC whiskers reached 630 MPa, with 2 percent elongation. This high strength is attributed to the uniform distribution of whiskers and finely dispersed aluminum oxide particles. Author

A92-15142**STRUCTURE AND MECHANICAL PROPERTIES OF FIBER REINFORCED SiC AND B4C COMPOSITES**

K. NAKANO, A. KAMIYA (Government Industrial Research Institute, Nagoya, Japan), and H. OKUDA (Tokai Carbon, Ltd., Fuji Institute, Gotemba, Japan) IN: Metal and ceramic matrix composites: Processing, modeling and mechanical behavior; Proceedings of the International Conference, Anaheim, CA, Feb. 19-22, 1990.

24 COMPOSITE MATERIALS

Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 185-192. refs

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Unidirectional carbon fiber-reinforced SiC and B₄C composites have been fabricated by a process consisting of slurry impregnation followed by hot pressing. Identification of crystal phase and observation of metallographic structures in the composites are carried out. Mechanical properties such as flexural strength and fracture toughness are measured and discussed in connection with the metallographic structures. Author

A92-15146

EVALUATIONS OF TOUGHNESS AND MECHANICAL PROPERTIES IN AL/SiC COMPOSITE

TOSHIRO KOBAYASHI, HIROYOSHI IWANARI (Toyohashi University of Technology, Japan), and KUNJI YAMAMOTO (TYK Corp., Ltd., Tajimi, Japan) IN: Metal and ceramic matrix composites: Processing, modeling and mechanical behavior; Proceedings of the International Conference, Anaheim, CA, Feb. 19-22, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 227-234. refs

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An SiC particle-reinforced 6061 Al alloy P/M-consolidated matrix composite has been subjected to tensile strength, Vickers hardness, and static and dynamic fracture toughness tests, in order to ascertain the effect of SiC particle volume fraction on fracture toughness. While tensile strength and Vickers hardness are found to increase with particle content, it is noted that elongation, dynamic fracture toughness, and crack-propagation toughness are drastically reduced. Although the micromechanism of fracture was that of void coalescence, deformation at the crack tip was constrained, and the unstable fracture was accelerated, by stress concentration in the higher volume fraction of SiC particles. O.C.

A92-15147

EFFECT OF DISLOCATION AND RECOVERY ON Si₃N₄ WHISKER REINFORCED ALUMINIUM P/M COMPOSITE

TSUNEMICHI IMAI, MAMOR MABUCHI, YOSHIO MURASE (Government Industrial Research Institute, Nagoya, Japan), YASUHISA TOZAWA (Daido Institute of Technology, Nagoya, Japan), and JUN KUSUI (Toyo Aluminium, Hino, Japan) IN: Metal and ceramic matrix composites: Processing, modeling and mechanical behavior; Proceedings of the International Conference, Anaheim, CA, Feb. 19-22, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 235-242. refs

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After very fine aluminum alloy powders (2124, 6061 and 7064 Al, -44 microns) were mixed uniformly with Si₃N₄ whisker, Si₃N₄ whisker-reinforced aluminum composites were fabricated by hot pressing before hot extrusion. The effect of strain rate and temperature on mechanical properties was investigated. Flow stress of the composite increased more than that of aluminum alone with increasing strain rate at elevated temperature. Fracture strain decreased monotonously with raising strain rate. High strain rate deformation produced a tangle-dislocation network, but low strain rate deformation decreased dislocation. Si₃N₄ whisker induced small and stable grain size and Si₃N₄ whisker-reinforced 2124, 6061 and 7064 Al composites produced superplastic deformation of about 250 percent at the strain rate of about 0.2/s. Author

A92-15149

ARE THERE FATIGUE EFFECTS ON CERAMICS AND CERAMIC MATRIX COMPOSITES UNDER CYCLIC LOADING?

TORU FUJII (Doshisha University, Kyoto, Japan), AZAR PARVIZI-MAJIDI, and TSU-WEI CHOU (Delaware, University, Newark) IN: Metal and ceramic matrix composites: Processing, modeling and mechanical behavior; Proceedings of the International Conference, Anaheim, CA, Feb. 19-22, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 253-260. refs

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Up-to-date published results on cyclic fatigue of glass, some ceramics and ceramic matrix composites (CMCs) are reviewed. Glass and SiC do not show appreciable cyclic effect while some

other ceramics show some. As for cyclic fatigue of CMCs, the focus has been on carbon/graphite and SiC fiber reinforced glass and glass ceramic composites. Due to the limited number of data on cyclic fatigue of CMCs, no concrete assessment can be given. A cyclic fatigue model based on pure slow crack growth (SCG) where no cyclic effects exist, is proposed for monolithic ceramics. This model relies on the phenomenon of crack closure due to rough crack surfaces and obstacle particles. Some plausible mechanisms are also proposed to explain cyclic fatigue of CMCs. Author

A92-15304

DEVELOPMENT OF REINFORCEMENT FIBRES IN JAPAN

JUNICHI MATSUI and MAKOTO HIRATA (Toray Industries, Inc., ACM Technology Dept., Tokyo, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 30-34. refs

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Reinforcement fibers for composite materials under production and development are reviewed. They are filament yarns of glass, carbon, aramid, silicon carbide, alumina, polyethylene, aromatic liquid crystal and so on, and whiskers of silicon carbide, silicone nitride, potassium titanate and zinc oxide. Mechanical properties of the fibers and application of the composite materials thereof are presented. Author

A92-15306

TOUGHENING MECHANISM OF FIBER-REINFORCED CERAMIC MATRIX COMPOSITES

YUTAKA KAGAWA and TERUO KISHI (Tokyo, University, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 44-53. refs

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The toughening mechanism of continuous fiber-reinforced ceramic matrix composites has been studied using SiC(CVD) fiber-reinforced glass model materials. The interfacial shear properties of the composite were evaluated by the single-fiber pullout method. The toughening due to the crack bridging of the fiber was directly observed by a special lighting method. The crack bridging force of the bridged fiber was directly obtained from the experimental results. Simple modeling was carried out to describe the crack-bridging process. Author

A92-15308

FATIGUE FRACTURE MECHANISMS OF SiC WHISKERS OR SiC PARTICULATES REINFORCED ALUMINIUM MATRIX COMPOSITES

CHITOSI MASUDA, YOSHIHISA TANAKA (National Research Institute for Metals, Tokyo, Japan), and MINORU FUKAZAWA (Tokai Carbon, Ltd., Fuji Institute, Shizuoka, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 62-67. refs

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Fatigue fracture mechanisms were examined for three commercially fabricated aluminum matrix composites containing SiC whiskers (SiCw) and SiC particles (SiCp) under rotating bending fatigue condition. Fatigue strengths were higher for SiCw/A2024 and SiCp/A357 composites than those for matrix alloys, while for SiCp/A356 composite at the volume fraction of 20 percent the fatigue strength was equivalent to that of the matrix alloy. Fractography revealed that fatigue cracking would initiate by a slip-deformation mechanism from the matrix for SiCw/A2024 and SiCp/A357 composites, while for SiCp/A356 composite fatigue crack would initiate from many voids situated in the matrix. Fatigue crack initiation models were proposed to discuss the fatigue strength for three composites used in this study. Author

A92-15309

WEATHERING TEST OF AFRP COMPOSITES FOR THE APPLICATION OF HELICOPTER FUSELAGE

KOJI ITOH, YOSHIOKI FUKUI, and NAOYUKI TANAKA (Kawasaki Heavy Industries, Ltd., Aerospace Engineering Dept., Kobe, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 83-88.

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An investigation is conducted of the weatherability of an aramid fiber-reinforced polymer (AFRP) composite intended for helicopter airframe application. The weathering tests encompassed salt-spraying, accelerated exposure, and ocean-atmosphere weathering, as well as immersion in various fluids. The flexure strength of uncoated AFRP (Nomex honeycomb-cored) sandwich panels is severely degraded by the ocean-atmosphere environment. Polyurethane coatings and a laminated polyfluorovinyl film are found to be effective protection for AFRP. O.C.

A92-15311

FRACTURE TOUGHNESS OF ADVANCED WHISKER REINFORCED METAL MATRIX COMPOSITES

KAZUMI HIRANO and TSUMOTU SASAKI (Mechanical Engineering Laboratory, Tsukuba, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 115-120. Research supported by MITI. refs

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The purpose of this paper is to establish and standardize a plane-strain fracture toughness K_{Ic} test method for whisker- or short fiber-reinforced metal matrix composites. Fracture toughness tests were conducted on SiC whisker-reinforced high strength aluminum alloys. Effects of whisker volume fraction and of whisker orientation on fracture toughness characteristics were studied on the basis of linear elastic fracture mechanics and electron microfractography. Ultimate tensile strength greatly increased with increasing whisker volume fraction, but the increase in the whisker volume fraction resulted in a rapid decrease of apparent K_{Ic} . Some problems in evaluating a valid K_{Ic} are discussed. Author

A92-15313

FLEXURAL TESTING AND EVALUATION METHODS OF ADVANCED COMPOSITE MATERIALS

MASUJI UEMURA and HIROSHI IWAI (Nihon University, Narashino, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 134-139. Previously announced in STAR as N91-19228. refs

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The effects of various factors such as loading mode, specimen size, radius of loading nose, control mode of loading, etc. on the static and fatigue flexural properties were investigated, using the unidirectional carbon-fiber reinforced plastics (CFRP) as specimens. Those factors were found to have the appreciable effects on the flexural properties obtained by conventional 3- and 4-point flexural tests. The failures took place just beneath the loading points due to stress concentration in experiments, as proved by the numerical finite element method analysis. Finally, the recommendations for improving the flexural tests are proposed. The fatigue flexural tests are discussed. Author

A92-15315

TENSION-TENSION AND DELAMINATION FATIGUE PROPERTIES OF CF/EPOXY LAMINATES

CHOACHIRO NAGASAWA, MASAKI HOJO, KIYOSHI KEMMOCHI (Agency of Industrial Science and Technology, Industrial Products Research Institute, Tsukuba, Japan), HIDEKI SEMBOKUYA, HIROSHI MAKI (Takushoku University, Hachioji, Japan), and

KASUTOSHI ENDO (Lion Corp., Tokyo, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 149-156. Previously announced in STAR as N91-20227. refs

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The effects of the stress ratio on tension-tension fatigue behavior and growth of delamination fatigue cracks were investigated for Toray T300/3601, T800/3631, and T800/3601 laminates. Unidirectional laminates and (+45/0/90) sub 2S laminates were used for tension-tension fatigue tests. The slopes of the S-N curves were small for all laminates. The influence of the stress ratio appeared to be smaller when the maximum stress was used for the S-N curve than when the stress range was used. Tests of delamination fatigue crack growth of unidirectional laminates were carried out under mode I opening loading with double cantilever beam specimens. Exponents of the power functions were high. The analysis of the equivalent stress intensity range showed that the contribution of the maximum load was high. Similar analysis was carried out for the tension-tension fatigue tests. Mechanisms of tension-tension fatigue fracture were discussed on the bases of the stress ratio dependency and the fractographic observations. Author

A92-15316

STUDIES ON THE TESTING METHOD OF CARBON FIBER REINFORCED PLASTICS - COMPRESSION, SHEAR AND IMPACT TESTS

HIROO MIYAIRI, MASAHIRO NAGAI, and KAZUO TAKAKUDA (Tokyo Medical and Dental University, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 198-210. Previously announced in STAR as N91-18219. refs

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In order to develop applications of new materials that will advance industrial equipment, high performance aircraft, high grade sports gear, etc., standards of testing methods for these materials must be established. Hence in this decade, the Japanese have performed research studies of the standardization of testing methods for such new materials as metal, organic, rubber, and inorganic materials. Since carbon reinforced plastics are so popular and promising, the Ministry on International Trade and Industry (MITI) started the standardization project in 1985 and supported the Japan High Polymer Center for their activity. The status of this project on fiber reinforced materials is presented, and the items of recent work are discussed. Author

A92-15317

A STUDY ON PREDICTION OF LIFE DUE TO CREEP BEHAVIOR IN CF/EPOXY AND CF/PEEK LAMINATES

KIYOSHI KEMMOCHI, NAOTO KOSHIZAKI, MASAKI HOJO, HIROSHI TAKAYANAGI, CHOACHIRO NAGASAWA, and RYUICHI HAYASHI (Agency of Industrial Science and Technology, Industrial Products Research Institute, Tsukuba, Japan) IN: Advanced composite materials - New materials, applications, processing, evaluation and databases; Proceedings of the 1st France-Japan Seminar on Composite Materials, Le Bourget, France, Mar. 13, 14, 1990. Paris, SIRPE Publishers, 1990, p. 211-218. Previously announced in STAR as N91-19226. refs

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The prediction of life for quasi-isotropic graphite/epoxy and graphite/PEEK laminates was carried out by utilizing the data obtained from short term creep tests at elevated temperatures. Curve-fit equations and numerical techniques were developed for the efficient life evaluation of the polymer composites. A microcomputer-based test system for automatic creep testing and analysis was developed. The time and temperature dependent response of the composites seems to correlate well with the master curve obtained by using the short term creep data together with a numerical curve fit program. Author

24 COMPOSITE MATERIALS

A92-15500

MECHANICAL PROPERTIES OF EPOXY RESIN FILLED WITH GRAPHITE FLUORIDE

KIMIHIRO ADACHI, MUNEAKI YAMAGUCHI, MUTSUHIRO WAKANO, TOSHIMITU TANAKA, and KATSUTOSHI TANAKA (Osaka, Government Industrial Research Institute, Ikeda, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 40, Oct. 1991, p. 1365-1371. In Japanese. refs

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Dynamic mechanical properties, compressive strength σ_c , Vickers hardness, and SEM observations of epoxy resins filled with various graphite fluoride (GF) powders of $(\text{CwF})_n(\text{C2F})$ and $(\text{CF})_n(\text{C1F})$ in the range of 0-30 wt pct were studied. The glass transition temperature and the storage modulus E' of all specimens increased with increasing GF content. The effect of filler on E' is found. The affinity of GF powders to epoxy resin was larger than that of carbon powders. The σ_c and Vickers hardness were strongly influenced by the GF powder morphological factors and their concentrations. The σ_c values of the C1F-filled specimens were larger than those of the C2F-filled specimens. C.D.

A92-18639

DYNAMIC FRACTURE TOUGHNESS IN CERAMICS AND CERAMICS MATRIX COMPOSITES

T. KISHI (Tokyo, University, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 785-790. refs

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The dynamic fracture toughness K_{Id} of ceramics and ceramics matrix composite was evaluated both by the strain gage method and by the load deconvolution method over a wide range of loading rates, using both conventional Instron-type and the newly developed drop-type impact testing machines. The result was compared with the two-dimensional dynamic finite element method. Six kinds of ceramics were tested: fine and coarse grained alumina, tetragonal zirconia polycrystal, silicon carbide, silicon nitride, and sialon. Two kinds of SiC whisker and ZrO₂ particle-reinforced Al₂O₃ matrix composites were also tested. Lastly, the effect of operating temperature on dynamic fracture toughness was examined.

Author

A92-18640

ACOUSTIC EMISSION CHARACTERIZATION OF THE FRACTURE MECHANISM OF A HIGH COMPLIANT, GLASS-MATRIX COMPOSITE

N. TAKEDA, O. CHEN, T. KISHI (Tokyo, University, Japan), W. TREDWAY, and K. PREWO (United Technologies Research Center, East Hartford, CT) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 791-793, 795-799. refs

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The fracture mechanism of a highly compliant high-failure strain composite made from glass-matrix with randomly-oriented discontinuous carbon fibers was investigated by monitoring the asymmetric strain responses to both tensile and flexural loadings by the acoustic emission (AE) technique. The events, counts and count rates, locations, and the amplitude distribution histograms were recorded in real time during quasi-static loading. The examination of amplitude distributions at various loads showed that the AE method was sensitive enough to distinguish various fracture processes. I.S.

A92-18641

TRANSFORMED ZRO₂ VOLUME FRACTION IN AL₂O₃ MATRIX MULTI-TOUGHENING COMPOSITES

KOJI IKEDA and TERUO KISHI (Tokyo, University, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990,

Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 801-805, 807-809. refs

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Al₂O₃ matrix composites multitoughened with SiC whiskers and ZrO₂ particles are used to obtain information about what happens in multitoughened composites. By the help of Raman microspectroscopy and scanning electron microscopy, the following characteristics are revealed: (1) the stability of tetragonal ZrO₂ depends on the volume fraction and the distance from whisker in as-received specimens; and (2) the interaction between whisker and ZrO₂ particles provides additional fracture toughness, and this interaction can be attributed to microcracking following transformation. Author

A92-18642

FATIGUE CRACK PROPAGATION OF SiC WHISKER REINFORCED 6061 ALUMINUM ALLOY COMPOSITE

HITOSHI ISHII, KEIICHIRO TOHGO, and HIROYASU ARAKI (Shizuoka University, Hamamatsu, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 821-827. refs

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The fatigue strength and fatigue crack propagation (FCP) behavior of SiC whisker reinforced 6061-T6 aluminum-matrix composite fabricated by the high pressure infiltration method were studied. In addition to tensile strength, fatigue strength was increased by whisker reinforcement. However, because of the highly aligned whiskers to the L direction caused by the extrusion process they showed strong orientation dependence. The L orientation showed higher strengths than the T orientation. The FCP resistance in T-L or T-T oriented composites was lower than that in unreinforced 6061-T6 alloy, while in L-T oriented composites, deflected FCP occurred and great increases in the FCP resistance resulted by whisker reinforcement when comparison was made by the mode I stress intensity factor. Fractographic investigation was also made to clarify the fatigue mechanism of this composite. Author

A92-19108

AGING BEHAVIOUR OF AL₂O₃-PARTICLE-DISPERSED AL-CU-MG ALLOY COMPOSITE MATERIALS

SUSUMU IKENO, KENJI MATSUDA, HIROSHI ANADA, SHIZUO TADA (Toyama University, Japan), and KAZUHIRO KAWASHIMA (Nissan Motor Co., Ltd., Tokyo, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Nov. 1991, p. 752-758. In Japanese. refs

The aging behavior of Al₂O₃-particle-dispersed Al-3.96 pct Cu and Al-4.09 pct Cu-1.58 pct Mg alloy composite materials was investigated by microvickers hardness, electrical resistivity measurements, and TEM. In the case of an Al₂O₃/Al-3.96 pct Cu composite, Theta-prime phase precipitated on subgrain boundaries at an early aging stage at 423 K. After prolonged aging, an increased number of Theta-prime precipitates were seen inside grains. While GP zones formed normally in an Al-3.96 pct Cu alloy at this aging condition, no GP zones precipitated in the Al₂O₃/Al-3.96 pct Cu composite material and age hardening did not occur. On the contrary, age hardening was clearly observed in an Al₂O₃/Al-4.09 pct Cu-1.58 pct Mg composite aged at 423 K. In this composite, both GP zones and Theta-prime precipitates were found inside grains, being different from GPB zones and S-prime intermediate phases normally formed in an Al-4.09 pct Cu-1.58 pct Mg alloy. C.D.

A92-19109

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF SiC WHISKER/ADC12 ALUMINUM ALLOY COMPOSITES

NARITOSHI AOYAGI, SHOICHI TAKAHASHI, and YO KOJIMA (Nagaoka University of Technology, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Nov. 1991, p. 759-765. In Japanese. refs

Die casting of SiC whisker/ADC12 aluminum alloy composites was examined. The microstructure of composites with 0.9 mass pct Mg or Ti added to the matrix revealed Mg segregation at the boundary between the whisker agglomeration and matrix areas, and precipitates were observed in the composites with 0.9 mass pct Ti added. The interface between SiC whisker and matrix in the composites produced by die casting had good bonding except for a void which occurred in die casting. The tensile strength of composites did not always increase when whiskers were added, but the proof stress of Mg-containing SiC whisker composite increased in proportion to whisker volume fraction. The properties of whisker/ADC12-0.9 mass pct Ti matrix composites were similar to those of Mg-containing composites. C.D.

A92-19117

FRACTURE OF PARTICLES IN A PARTICLE/METAL MATRIX COMPOSITE UNDER PLASTIC STRAINING AND ITS EFFECT ON THE YOUNG'S MODULUS OF THE COMPOSITE

TETSUO MOCHIDA (Kawasaki Steel Corp., Chiba, Japan), MINORU TAYA (Tohoku University, Sendai, Japan), and DAVID J. LLOYD (Alcan International, Ltd., Kingston Research and Development Centre, Canada) *JIM, Materials Transactions (ISSN 0916-1821), vol. 32, Oct. 1991, p. 931-942. Research supported by Alcan International, Ltd. refs*
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Fracture of Al₂O₃ particles in an Al₂O₃ particle/aluminum alloy metal matrix composite (MMC) under plastic straining was observed by in situ tensile testing in a scanning electron microscope. The fracture of larger sized particles was found to be preferred to that of smaller-sized ones for a given plastic strain. The Young's modulus (Ec) of plastically strained MMC was reduced with an increase in plastic strain. The analytical model based on Eshelby's equivalent inclusion method was constructed to explain the relationship between Ec and plastic strain, resulting in good agreement with the experimental results. Author

A92-19711

EVALUATION OF FRACTURE MECHANICS CHARACTERISTICS OF ALUMINA PARTICULATE FILLED EPOXIDE COMPOSITE

H. KOBAYASHI, Y. ARAI, H. NAKAMURA, T. KOIDE (Tokyo Institute of Technology, Japan), A. IEYASU (Nisshin Electric, Inc., Japan), and Y. KAJIYAMA *IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 635-640. refs*
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Basic fracture mechanics characteristics are examined such as: plane strain fracture toughness, fracture resistance, and crack growth of stress corrosion cracking and fatigue. The results obtained are summarized as follows: the resistance to stable crack growth as well as the fracture initiation is described as $K = K_{sub Ic}$ where $K_{sub Ic}$ is the plane strain fracture toughness; (2) below $K_{sub Ic}$, stress corrosion cracking occurs. The threshold stress intensity is 0.89 $K_{sub Ic}$; (3) the threshold stress intensity for fatigue-crack growth is smaller than the value of the threshold stress intensity indicated. A marked influence of the stress ratio on the fatigue-crack growth rates is observed. Author

A92-19717

FATIGUE PROCESS IN SHORT CARBON FIBER REINFORCED THERMOPLASTICS

H. NISITANI, H. NOGUCHI (Kyushu University, Japan), and T. HARADA (Kitakyushu Industrial Research Institute, Japan) *IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 697-702. refs*
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Static bending tests and rotating bending fatigue tests were carried out on an injection-molded carbon-fiber-reinforced polyamid 6.6 composite. The diameter and average length of carbon fiber

were 7 and 250 microns, respectively, and the weight fraction of carbon was 30 percent. The characteristics of static fracture and fatigue in this composite were studied through the successive surface observations using the plastic replica method. As a result of the observations, it was found that fatigue cracks nucleate near the end of fiber parallel to the specimen axis along the fiber by cyclic shearing strain, and then propagate in the circumferential direction of the specimen. Author

A92-19727

FATIGUE PROPERTIES OF SiC WHISKER-REINFORCED ALUMINUM CAST ALLOY AT ELEVATED TEMPERATURES

N. HASEGAWA (Gifu University, Japan) *IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 851-856. refs*
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Fatigue tests in rotating bending were made on a random SiC-whisker-reinforced cast-aluminum alloy (SiC/AC8A) and an aluminum-cast alloy (AC8A) in a range of room temperature to 350 C. The fatigue strength of SiC/AC8A is superior to that of AC8A at room temperature and 350 C. The fatigue strength of SiC/AC8A at 350 C does not reduce with increased holding times at 350 C. The increase in the fatigue life of SiC/AC8A is due to the increase in the number of cycles for crack initiation. The crack-propagation rate of SiC/AC8A is decreased by the SiC whisker reinforcement. Author

A92-19728

FATIGUE CRACK PROPAGATION IN SiC WHISKER REINFORCED ALUMINUM ALLOY

K. TANAKA, M. KINEFUCHI (Kyoto University, Japan), and Y. AKINIWA (Kyushu Institute of Technology, Kitakyushu, Japan) *IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 857-862. refs*
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Fatigue-crack propagation tests were conducted with compact tension (CT) specimens and center-notched specimens of 2024-T6 aluminum alloy with 20-pct volume fraction of SiC whiskers. For the cases of CT specimens with the T-L orientation, the crack-propagation behavior near the threshold in SiC/Al was nearly identical to that in 2024-T6. For CT specimens with the L-T orientation, the crack growth path was curved. The crack propagation rate near the threshold of SiC/Al was much slower than that of 2024-T6. The crack closure was maximum in CT specimens of the L-T orientation. The relation between the crack-propagation rate and the effective stress intensity range was nearly identical for all the cases. For the cases of center-notched specimens with the L-T orientation, a crack propagated straight. The crack stability was discussed in terms of the nonsingular T-stress effect. Author

A92-19729

FATIGUE CRACK GROWTH CHARACTERISTICS OF WHISKER REINFORCED ALUMINUM ALLOYS

KAZUMI HIRANO (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) *IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 863-868. refs*
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It is important to characterize the damage-tolerance behavior in the wide use of advanced MMCs for primary aerospace and automotive structural applications. Fatigue-crack growth testings were conducted on whisker-reinforced aluminum alloys. The fatigue-crack growth characteristics covering the threshold stress-intensity-factor range were evaluated on the basis of fracture mechanics and electron microfractography. It was found that the whisker reinforcement of the high-strength aluminum alloy 7075-T6

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is not always effective for improving the fatigue-crack-growth resistance, although it is effective for aluminium alloy 2025-T6.

Author

A92-19730

FATIGUE CRACK GROWTH IN SiC PARTICULATE-REINFORCED ALUMINIUM ALLOYS

S. KUMAI (Tokyo Institute of Technology, Japan), J. E. KING, and J. F. KNOTT (Cambridge, University, England) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 869-874. Research supported by British Gas, PLC. refs

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Fatigue-crack initiation and short and long crack-growth behavior are examined in liquid-metal processed 2014-5 wt pct SiC aluminum-alloy composites. Distributed SiC particles provided preferential crack-initiation sites, but they also acted as crack arresters for microstructurally short cracks. The increase in crack-growth rates of long cracks compared with unreinforced matrix alloys was attributed to a monotonic fracture-mode contribution resulting from distributed SiC particles.

Author

A92-19738

FATIGUE PROPERTY OF NICKEL-FOAM REINFORCED ALUMINUM ALLOY

K. SHIOZAWA, S. NISHINO (Toyama University, Japan), and T. MIZUGUCHI (Toyama Murata Co., Ltd., Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 917-922. Research supported by Tamura Foundation for Encouragement of Science and Technology. refs

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The strength of nickel-foam reinforced aluminum alloy (NFRA) is evaluated with clarification of the fatigue behavior of this material. Fatigue tests and tensile tests were carried out on two types of NFRA and AC8A aluminum alloy. It was observed that two types of intermetallic compound were formed at the interface between nickel-foam and base metal. The hardness is about ten times harder than that of base metal. The fatigue life and tensile strength of NFRA decreased significantly as compared with those of AC8A. Many cracks were initiated at the interface between intermetallic compound and the base metal during the fatigue process. Fatigue cracks of NFRA propagate with the coalescence of many microcracks which was very different from homogeneous materials such as AC8A aluminum alloy.

Author

A92-19739

FATIGUE BEHAVIOR OF CONTINUOUS-FIBER REINFORCED ALUMINUM MATRIX COMPOSITES AT TEMPERATURES BETWEEN 295 K AND 673 K

Y. NAKAYAMA (Osaka Prefecture, University, Sakai, Japan) and H. MABUCHI (Japan Institute of Light Metals, Journal, vol. 38, Oct. 1988, p. 608-613) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 923-928. Previously cited in issue 07, p. 940, Accession no. A89-20930. refs

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A92-20095

STRESS FIELDS ON AND BENEATH THE SURFACE OF SHORT-FIBER-REINFORCED COMPOSITES AND THEIR FAILURE MECHANISMS

N. S. CHOI and K. TAKAHASHI (Kyushu University, Kasuga, Japan) Composites Science and Technology (ISSN 0266-3538), vol. 43, no. 3, 1992, p. 237-244. refs

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A92-20495

FATIGUE CRACK GROWTH BEHAVIOUR IN MOLTEN-METAL PROCESSED SiC PARTICLE-REINFORCED ALUMINIUM ALLOYS

SHINJI KUMAI (Tokyo Institute of Technology, Japan), JULIA E. KING, and JOHN F. KNOTT (Cambridge, University, England) Fatigue and Fracture of Engineering Materials and Structures (ISSN 8756-758X), vol. 15, Jan. 1992, p. 1-11. refs

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The effect of the distributed SiC particles and other constituent particles in aluminum alloy/SiC (2014/5-wt-pct-SiC) composites on the fatigue-crack initiation and subsequent short-crack-growth behavior of this composite was investigated using micrographic observations and the results of four-point bend loading tests. Preferential crack initiation sites were found to be matrix-SiC interfaces and at (Fe,Mn)₃SiAl₁₂ particles. The regime of microstructurally short crack growth persisted from crack initiation to crack depths of about 200 microns. At crack depths greater than 200 microns, the 'short'-crack data at R = 0.1 were in good agreement with conventional long-crack data measured at stress ratio R = 0.2 and R = 0.5, indicating an absence of crack-closure effects in the Paris region.

I.S.

A92-20750

OPTIMUM FIBER ANGLE OF UNIDIRECTIONAL COMPOSITES FOR LOAD WITH VARIATIONS

MITSUNORI MIKI, YOSHISADA MUROTSU (Osaka Prefecture, University, Sakai, Japan), and TETSUO TANAKA AIAA Journal (ISSN 0001-1452), vol. 30, Jan. 1992, p. 189-196. Research supported by Mazda Foundation and MOESC. Previously cited in issue 11, p. 1640, Accession no. A90-29358. refs

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A92-21102

DENSITY AND MICROSTRUCTURE OF CVD SiC-NANOCOMPOSITES

Y. WANG, M. SASAKI, and T. HIRAI (Tohoku University, Sendai, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 26, Dec. 15, 1991, p. 6618-6624. refs

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Density, microstructure and preferred crystal orientation of CVD SiC-C nanocomposites were studied for every composition from SiC to C. The relationships between these properties are discussed. The CVD SiC prepared in this work was dense with its density close to the theoretical value. However, some pores were formed by addition of dispersed C. The densities of CVD C were as low as about 80 percent of the theoretical value. The densities approached close to the theoretical density by adding a small amount of SiC. The preferred crystal orientations parallel to the substrate were (110) or (111) for CVD SiC and (002) for CVD C. When the quantity of dispersion phases exceeds a certain value, a decrease in the preferred orientation is found for both SiC and C matrices and the formation of pores becomes much easier.

Author

A92-21112

DIFFUSION-PREVENTIVE AL₂O₃ LAYER GROWTH AT THE INTERFACE OF PLASMA-SPRAYED NIOBIUM AND FeCrAlY IN A TUNGSTEN FIBRE-REINFORCED HIGH-TEMPERATURE SUPERALLOY COMPOSITE

S. OKUDE, M. ITOH, T. SUZUKI, and M. NAKAHASHI (Toshiba Corp., Toshiba Research and Development Center, Kawasaki, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 26, Dec. 15, 1991, p. 6809-6816. refs

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The growth mechanism of a diffusion-preventive layer formed at high temperatures between the plasma-sprayed Nb layer and the plasma-sprayed FeCrAlY matrix in a Nb-coated tungsten-fiber/FeCrAlY composite was investigated using SEM/electron probe microanalysis, EDAX, and XRD to identify the diffusion-preventive layer. This layer was identified as alpha-Al₂O₃. Results of heat-treatment experiments indicated that

the Al₂O₃ layer was also formed at the plasma-sprayed Nb/rolled FeCrAl interface, but not at the rolled Nb/plasma-sprayed FeCrAl interface or at the rolled Nb/rolled FeCrAl interface. A growth mechanism is proposed according to which the formation of Al₂O₃ is a result of a chemical reaction between the residual oxygen in the plasma-sprayed Nb and Al in FeCrAlY or FeCrAl. The proposed growth mechanism was shown to be plausible by numerical calculations of the magnitude of the driving force, made in the framework of a model based on thermodynamics. I.S.

A92-21261

SUPERPLASTIC BEHAVIOR IN A MECHANICALLY ALLOYED ALUMINUM COMPOSITE REINFORCED WITH SiC PARTICULATES

K. HIGASHI, T. OKADA, T. MUKAI, S. TANIMURA (Osaka Prefecture University, Sakai, Japan), T. G. NIEH, and J. WADSWORTH (Lockheed Missiles and Space Co., Inc., Research and Development Div., Palo Alto, CA) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Jan. 15, 1992, p. 185-190. Research supported by Lockheed Independent Research Program. refs

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The discovery of very-high-strain-rate superplasticity in a mechanically alloyed 15 vol pct SiCp/IN9021 aluminum composite is reported. Tensile elongations of more than 500 pct were obtained at strain rates between 5 to 100/s at 823 K. The maximum elongation of 610 pct was recorded at 6/s and 823 K. The potential for high-strain-rate superplasticity in this mechanically alloyed composite is found to be superior to a number of other reinforced aluminum composites. In particular, the superplastic strain rates were many orders of magnitude higher than those for typical superplastic alloys. It is demonstrated that mechanically alloyed composites can exhibit superplasticity in the very high strain rate over 1/s. C.A.B.

A92-21273

MECHANICAL BEHAVIOR OF AL66CR9Ti25-AL2O3 COMPOSITES

M. OTSUKI (Mitsubishi Materials Corp., Omiya, Japan) and N. S. STOLOFF (Rensselaer Polytechnic Institute, Troy, NY) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Jan. 15, 1992, p. 325-330. Research supported by Mitsubishi Materials Corp. and DARPA. refs

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The influence of short fibers of Al₂O₃ on the compressive properties of a cubic Al₆₆Cr₉Ti₂₅ alloy is determined. Vickers hardness and compressive tests were carried out on monolithic Al₆₆Cr₉Ti₂₅ as well as the composites. Compression tests were performed between 25 and 900 C at a nominal strain rate of 0.00034/s under an argon atmosphere. Fractured samples were examined by SEM. Chromium additions were found to stabilize the L1(2) structure in Al₃Ti. Reactive HIPing allows consolidation of powder compacts to full density. Short PRD166 Al₂O₃ fibers are readily incorporated into the alloy matrix without chemical reaction or excessive thermal mismatch stresses. Strengthening of the matrix is achieved by up to 30 vol pct Al₂O₃ fibers, but compressive ductility is sharply reduced. Continuous Al₂O₃ fibers are more likely to achieve improved ductility or toughness. C.A.B.

A92-21707

CREEP DEFORMATION AND FRACTURE OF AN ALUMINUM COMPOSITE REINFORCED WITH CONTINUOUS ALUMINA FIBRES

KEISUKE MATSUURA, NORIO MATSUDA (Yamagata University, Yonezawa, Japan), and MEIKON CHOU (Japan Institute of Metals, Journal, vol. 54, June 1990, p. 671-678) JIM, Materials Transactions (ISSN 0916-1821), vol. 32, Nov. 1991, p. 1062-1070. Translation. Research supported by MOESC and Light Metals Education Foundation of Japan. Previously cited in issue 20, p. 3169, Accession no. A90-44823. refs

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A92-23101

ACHIEVEMENT IN COMPOSITES IN JAPAN AND THE UNITED STATES; PROCEEDINGS OF THE 5TH JAPAN-U.S. CONFERENCE ON COMPOSITE MATERIALS, TOKYO, JAPAN, JUNE 24-27, 1990

AKIRA KOBAYASHI, ED. (Tokyo, University, Japan) Conference sponsored by Japan Society for Composite Materials, American Society for Composites, ASME, et al. Tokyo, Japan Society for Composite Materials, 1990, 720 p. For individual items see A92-23102 to A92-23171.

(ISBN 4-7722-1024-5) Copyright

The present conference on composites and related technologies encompasses ceramic matrix composites, impact, testing and NDI, composite structures, interlaminar fracture toughness, stress analysis, metal matrix composites, fiber reinforcement, fabrication and micromechanics, mechanical and thermal properties, damage and fracture, plates and shells, optimization, and vibration. Specific issues addressed include the mechanical properties of an SiC whisker/glass composite, the nonlinear transient analysis of a composite ATP blade model, compressive failure mechanisms of composite honeycomb cores, a global-local model for thick composite laminates, and thermodynamical stability between TiC and Ti. Also addressed are advances in Aramid-reinforced thermoplastic composites, the constitutive relation of shape-memory flexible composites, the effects of radiation on metal-matrix composites, progressive cracking in CFRP cross-ply laminates, and the compressive strength of graphite-PEEK laminates. C.C.S.

A92-23105

STRAIN MEASUREMENTS BY IMAGE PROCESSING TECHNIQUES AND ITS APPLICATION TO ULTRA-HIGH TEMPERATURE TENSILE TESTINGS OF CARBON/CARBON COMPOSITES

KAZUMI HIRANO (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 39-46. Research supported by MITI. refs

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It is necessary to investigate the micromechanism of deformation and fracture behavior at ultra-high temperature ranges (T greater than 1300 C) in order to develop and standardize the technology for advanced materials testing for primary aerospace and aeronautic structural applications. The newly developed testing facilities, by which it is capable of conducting the mechanical and fracture mechanics testings in vacuum and inert gas environments up to 2000 C, are firstly introduced. Secondly, it is reported in details the new strain measurement methodology based on image processing technique using a high resolution CCD camera. Finally, the researched and developed testing methodologies are applied to ultra-high temperature tensile and fracture mechanics testings of 2D carbon/carbon composites, and tensile strength and fracture characteristics are evaluated on the basis of fracture mechanics and electron microfractography. Author

A92-23106

THE EFFECT OF WHISKER DIMENSIONS ON MECHANICAL PROPERTIES OF SiC-WHISKER/AL2O3 COMPOSITES

E. YASUDA, T. AKATSU, and Y. TANABE (Tokyo Institute of Technology, Yokohama, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 63-69. Research supported by Asahi Glass Co., Ltd. refs

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Seven types of SiC-whiskers with different dimensions, were used for fabricating SiC-whisker/Al₂O₃ composites. Fracture toughness and effective fracture energy of these composites were measured as a function of whisker dimensions or whisker volume fraction. Fractured surfaces of these composites were observed

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in detail. All the results obtained support the pull-out mechanism of whiskers. Author

A92-23108

IN SITU FORMATION OF Al_2O_3/Si COMPOSITES BY DIRECTED OXIDATION OF LIQUID Al ALLOY

Y. KAGAWA (Tokyo, University, Japan), A. OKURA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and S. WATANABE (Nikkei Techno-Research Co., Ltd., Shizuoka, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 79-86. refs

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In situ formation of Al_2O_3/Si composite materials by the directed oxidation of liquid $Al-Mg-Si$ alloys was carried out. The typical composite was obtained by oxidizing an aluminum melt in dry air at temperatures of 1400 to 1700 K for 5-30 h. Microstructures of the composites were observed in detail. A method for simple modeling of the growth kinetics is discussed. The effects of additive elements on the growth mechanism of the Al_2O_3/Si composite can be explained by the simple model. Application of this process for the SiC fiber-reinforced Al_2O_3/Si composite is also discussed.

Author

A92-23110

THE MECHANICAL PROPERTIES IN HIGH VELOCITY TENSION OF CFRP, KFRP AND CF/KF HYBRID COMPOSITES

G. S. GER, K. KAWATA, and M. ITABASHI (Tokyo, Science University, Chiba, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 95-102. refs

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The characterization of CFRP, KFRP and CF/KF hybrid composites in dynamic tension at high strain rates up to the order of 1000/s was conducted using the one-bar method of block-to-bar type, modified for flat-specimen. Three patterns of stacking sequences for each composite were made by using a filament-winding technique with a specially designed mandrel. Static tensile tests were also conducted for comparisons with the dynamic behavior. Experimental data showed that results for both dynamic strength and modulus were higher than those of static values. Especially, in the case of + or - 45 deg laminates, the increase in dynamic strength was the most significant among three types of stacking sequence, amounting to twice as much as that of the static values. The synergistic effect in hybrids was also investigated. Both strength and modulus increase linearly with increasing volume percent of carbon fiber.

Author

A92-23118

MICROMECHANISM OF MODE I DELAMINATION FRACTURE IN GRAPHITE/EPOXY COMPOSITE

AKIRA TODOROKI (Tokyo Institute of Technology, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 177-184. refs

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A micromechanism is examined experimentally and modeled analytically which involves fiber bridging related to the roughness of the lamina boundary. Measurements are taken of the delamination crack-growth resistance in precracked specimens of a T-400 graphite-fiber composite undergoing controlled loading. The measurements are considered in the light of such factors as the large deflection of the beam and the loading jig employed, and the results of SEM and acoustic microscopy are discussed. The specimens show that for small deflection ratios between 0.1 and 0.25 the combined effects of the beam deflection with a finite boundary made up of jigs and a beam end point are negligible. The model described demonstrates that the roughness of the

boundary of the middle lamina is very important in determining the ultimate energy-release rate for the growth of a delamination crack. C.C.S.

A92-23119

INTERLAMINAR REINFORCEMENT OF LAMINATED COMPOSITES BY INTERMINGLED 3-Dimensionally ORIENTED MICRO FIBERS

S. YAMASHITA, H. HATTA, and T. TAKEI (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Sagami-hara, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 185-192. refs

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Mode-I interlaminar fracture toughnesses are determined experimentally to investigate the method of interlaminar reinforcement proposed by Yamashita et al. (1989). Double-cantilever-beam specimens of a hybrid laminate composite are measured to study the critical strain-energy release rate and thereby assess the mode-I interlaminar fracture toughness. The results are compared to conventional CFRPs, and it is noted that the hybridized reinforcements and carbon short fibers provide better interlaminar reinforcement than the whisker technique. An analysis that follows examines the contribution of the microfiber to fracture toughness by means of a fiber-bridging model that accounts for fiber pull-out. The experimental results are supported by the analytical results which give the optimum 3D parameters and microfiber orientational distributions for effective fracture toughness. C.C.S.

A92-23120

INFLUENCE OF SPECIMEN THICKNESS ON MODE I INTERLAMINAR FRACTURE TOUGHNESS OF AS4/PEEK AND T800/EPOXY LAMINATES

MASAKI HOJO (Agency of Industrial Science and Technology, Industrial Products Research Institute, Higashi, Japan), TAKAHIRA AOKI (Tsukuba, University, Japan), and YASUTOSHI TATEISHI IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 193-200. refs

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AS4/PEEK and T800/epoxy laminates milled to a variety of thicknesses are employed to determine the effects of specimen thickness on interlaminar fracture toughness. The specimens measure 3, 4, 5, and 8 mm and are milled from uniform 8-mm samples, and a computer-controlled servohydraulic testing machine is used to repeatedly load the cracked specimen until failure. The mode-I interlaminar fracture toughness (MIFT) for the AS4/PEEK samples showed propagation values that are constant with delamination crack growth. The T800/epoxy laminates have MIFT values that increase with crack length or are constant with crack length depending on the type of sample employed. The thickness effect is found to be smaller for the milled samples than for molded samples used in other situations. Fiber bridging is found to be more evident in the thicker AS4/PEEK laminates, but no such correlation is found in the epoxy laminates. C.C.S.

A92-23124

PROPOSED METHODS FOR INTERLAMINAR FRACTURE TOUGHNESS TESTS OF COMPOSITE LAMINATES

KAZURO KAGEYAMA (Tokyo, University, Japan) and MASAKI HOJO (Agency of Industrial Science and Technology, Industrial Products Research Institute, Tsukuba, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 227-234. refs

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Double-cantilever-beam (DCB) and ENF test methods are reviewed and test procedures are proposed. Thickness-normalized crack length versus cube-root compliance plots of DCB tests are

used to determine mode-I fracture toughness. Importance of measurement of crack-shear displacement (CSD) during ENF testing is described and a stabilized ENF test is proposed for the characterization of mode-II interlaminar crack growth. Mode-II fracture toughness can be calculated directly from load-versus-CSD diagrams without measuring crack length. The applicabilities of the proposed methods are confirmed by experiments of four composite systems, T300/2500, T800H/3631, APC-2 and Celion6000/PMR-15. Author

A92-23130

EFFECT OF THERMAL CYCLING ON MECHANICAL PROPERTIES OF CARBON FIBER REINFORCED ALUMINUM ALLOYS WITH PARTICULATES AND WHISKERS

HAJIME IKUNO, SHIN-ICHI TOWATA, and SEN-ICHI YAMADA (Toyota Central Research and Development Laboratories, Inc., Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 293-300. refs Copyright

High-modulus- and high-strength-type carbon-fiber reinforced Al-5Mg alloy composites with dispersoids of fine particulates and whiskers were prepared by squeeze-casting to investigate the effects of interfacial bonding strength between the fiber and the matrix on their mechanical properties after thermal cycling. Residual expansion occurred in the transverse direction during thermal cycling for both composites. The expansion increased with the temperature variation of cycles, namely, with the plastic strain of the matrix. The transverse strengths and longitudinal elastic moduli of both composites reduced after thermal cycling. The longitudinal strength of the high-strength carbon composite slightly increased after thermal cycling, whereas it decreased for the high-modulus carbon composite. Critical strain, indicating the point of thermal fatigue damage generation, is higher for HS-FRM, which is attributable to its high interfacial bonding strength between the fiber and the matrix. Author

A92-23131

EFFECT OF THERMAL CYCLING ON THE PROPERTIES OF ALUMINA SHORT FIBER-REINFORCED ALUMINUM

M. NAKANISHI, Y. NISHIDA (Government Industrial Research Institute, Nagoya, Japan), and Y. SAKAI (Daido Institute of Technology, Nagoya, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 301-308. refs Copyright

Alumina short-fiber-reinforced 99.9-pct aluminum and JIS AC8A-alloy composites with different fiber-volume fractions fabricated by squeeze-casting were subjected to thermal cycling in a temperature range between 100 and 400 C. After the thermal cycling, tensile tests were performed and the fracture surface was observed in order to examine the effect of thermal cycling on the mechanical properties of the composites. The tensile strength of the AC8A-alloy matrix composite decreased due to thermal cycling, whereas that of the pure aluminum-matrix composite was unchanged until 2000 thermal cycles. The increase in brittleness due to thermal cycling was observed for pure aluminum-matrix composite. The change of mechanical properties of the composite was attributed to local plastic deformation or to the change of microstructure of the matrix. Author

A92-23132

MIXED MODE (I, II) FATIGUE CRACK GROWTH CHARACTERISTICS OF CONTINUOUS SiC(CVD) FIBER REINFORCED ALUMINIUM AND TITANIUM ALLOYS MATRIX COMPOSITES

KAZUMI HIRANO (Agency of Industrial Science and Technology, Mechanical Engineering Laboratory, Tsukuba, Japan), MASAKI KIKUCHI (Tokyo, Science University, Japan), and SINJI SETO IN: Achievement in composites in Japan and the United States;

Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 311-319. Research supported by MITI. refs

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The goal of this study is to establish the material design concepts for high performance (high strength, high toughness and high durability) metal matrix composites. Fatigue crack growth tests under the mixed mode (Modes I and II) loading conditions were conducted on continuous SiC(CVD) fiber unidirectionally reinforced aluminum and titanium alloys matrix composites. J-integral analyses for the mixed mode crack were also done by finite element method using isoparametric elements. The mixed mode fatigue crack growth characteristics were evaluated on the basis of fracture mechanics and electron microfractography. Author

A92-23133

HIGH-TEMPERATURE FATIGUE CRACK GROWTH OF SCS6/TI-6AL-4V METAL-MATRIX COMPOSITE

Y. NAKAJO (Ashikaga Institute of Technology, Japan) and S. S. WANG (Illinois, University, Urbana) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 329-336. refs

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Fatigue crack growth experiments were conducted on double edge notch specimen of SCS6/Ti-6Al-4V unidirectional metal-matrix composite both at room temperature and at 316 C along with experiments for monotonic fracture toughness. The results clearly depict the high-temperature effects on basic material service and design. For transverse fatigue crack growth, commonly used $\Delta K_{J-da/dN}$ data reduction is successfully conducted, but for longitudinal fatigue crack growth, the same $\Delta K_{J-da/dN}$ data reduction is found to be invalid because it cannot account for perpendicular cracking, fiber debonding, or developing plastic zone which are undertaking during the longitudinal fatigue crack growth. Author

A92-23135

THE RELATIONSHIP BETWEEN INTERFACIAL REACTION AND TENSILE STRENGTH OF SiC FILAMENT REINFORCED Ti ALLOY COMPOSITES

YOSHIO IMAI, YOSHIKAZU SHINOHARA, SUSUMU IKENO, and ICHIRO SHIOTA (National Research Institute for Metals, Tokyo, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 347-354. Copyright

Ti-alloy-matrix composites are fabricated by means of diffusion bonding and heat-treated, and an investigation is undertaken of the reaction products and their effects on the composites' strengths. The Ti alloys include Ti-6Al-4V and Ti-8Mo/Ti-6Al-4V and are reinforced with SiC filaments and heat-treated at 1023-1123 K for 32.4-360 ks. The strength of the Ti matrices is found to decrease by up to 60 percent at the higher-temperature longer-duration treatments. The reaction products include TiC on the filament surfaces and a layer of Ti₅Si₃ on the TiC surface, and the reaction-rate constants and activation energies are given. The results suggest that the alloying elements effectively inhibit the interface reaction but that defects in the reaction products causes a significant decrease in composite strength. C.C.S.

A92-23141

MECHANICAL CHARACTERIZATION OF FIBERS AS REINFORCEMENT FOR COMPOSITES

S. KOHARA (Tokyo, Science University, Noda, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 403-408. refs

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The mechanical properties of fibers as the reinforcement for composites were evaluated by the Weibull analysis. Two types of carbon fibers (high-strength and high-modulus) and silicon carbide fiber were tested. The tension test of the fiber specimen was carried out with a tensile testing apparatus for monofilament. The fracture strength data of fibers agreed well with the Weibull distribution function. The fracture strength of fibers increased with the decreasing specimen length. However, the constancy of the Weibull modulus is found over the specimen length tested. The surface flaw size is estimated from the value of fracture strength obtained. Author

A92-23146

COMPARISON OF TENSILE AND COMPRESSIVE PROPERTIES OF SOME STRUCTURAL ELEMENTS BETWEEN CARBON/PEEK AND CARBON/EPOXY COMPOSITES

TAKASHI ISHIKAWA, MASAMICHI MATSUSHIMA, YOICHI HAYASHI (National Aerospace Laboratory, Mitaka, Japan), and TATSURU NOGUCHI (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 445-452. refs Copyright

An overview is presented of significant results from a long-term study of CF/PEEK and CF/epoxy laminates which indicate significant strength increases and direct aerospace applications. Attention is given to NDE methods employed during fatigue loading to monitor delamination propagation in the tension-tension fatigue tests and the compression tests. Results are given from the ultrasonic C-scan testing, soft X-ray examinations, thermography, and moire topography. The high fracture toughnesses of the CF/PEEK composites account for the improved test values for tension-tension fatigue and compression after impact in the thick plates. The good fracture toughness significantly reduces delamination in the plates and allows high values of compressive strain in T-stiffeners. The results indicate that the CF/PEEK composites are superior to the CF/epoxy composites and are therefore more suitable for a wide variety of lightweight aerospace uses. C.C.S.

A92-23149

MECHANICAL PROPERTIES AND UV DEGRADATION OF CARBON FIBER REINFORCED PLASTICS

M. ISHIBASHI, Y. KAGA, J. FUJIMOTO (NEC Corp., Resources and Environment Protection Research Laboratories, Kawasaki, Japan), and T. TANIMOTO (Shonan Institute of Technology, Fujisawa, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 471-478. refs Copyright

Tensile strength and fatigue properties of carbon fiber reinforced plastics have been studied with special emphasis on UV irradiation effect. The materials used are T800/3631, T300/3601, epoxy resin matrix composites, and APC-2, PEEK resin matrix composites. UV irradiation was accomplished by Hg arc lamp. Test results indicated that the surface resins were diminished because of UV degradation. In particular, fatigue strength showed a tendency to decrease due to the UV effect on epoxy resin matrix composites, T800/3631 and T300/3601. Author

A92-23150

EFFECTS OF RADIATION ON METAL MATRIX COMPOSITES

A. KOHYAMA (Tokyo, University, Japan), H. TEZUKA (Tokyo Electric Power Co., Engineering Research Center, Chofu, Japan), K. HAMADA, and S. SATO (Tokyo, University, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 487-494. refs Copyright

The objectives of this investigation are to evaluate potential of

Al matrix composites as low activation fusion reactor materials and to develop them for fusion applications. Mechanical properties were measured by three point bend test and mini size specimen tensile test for composite materials and monofilament tensile test. Microstructure was inspected by means of SEM and TEM. The effects of irradiation were studied using fission neutrons. Al matrix composite showed excellent stability under irradiation up to a certain fluence, named threshold fluence. For SiC fibers in the composites, an increment of tensile strength and Young's modulus and crystallization of amorphous SiC was observed below the threshold fluence. But at above the threshold fluence, strength drastically dropped. The addition of Ni and Si to matrix Al alloys is thought to be detrimental for SiC/Al composite materials used under fusion environment. Author

A92-23153

ON COMPOSITE MATERIALS STRENGTH EVALUATION SUBJECT TO THERMAL ENVIRONMENT

A. KOBAYASHI, S. OGIHARA, N. OHTANI, and N. TAKEDA (Tokyo, University, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 513-520. refs Copyright

The tensile strengths of two cross-ply composites are investigated to determine the corresponding dependences on temperature. Specimens of T300/3601 and T800/3632 are employed, fabricated in both the (0/90/0) and (90/0/90) stacking sequences. Tensile testing is performed at room temperature (RT) and 80 C, and the temperature dependence of strength is found to be similar for both composite systems. The (0/90/0) laminates exhibit higher strengths at RT, and the (90/0/90) laminates exhibit higher strengths at 80 C. Microscopic observations of the transverse crack density and the delamination length are correlated with applied stress and temperature to describe the interrelationships. Transverse crack density is found to depend on the ultimate strength, and it is shown that the fiber-matrix interfacial bond strength and delamination are key parameters for studying transverse cracking. C.C.S.

A92-23154

ON THE MICROMECHANICAL FAILURE PROCESS OF SINGLE CARBON FIBER AND STRAND IN A MATRIX

ISAO KIMPARA, KAZURO KAGEYAMA (Tokyo, University, Japan), EIJI TSUSHIMA, JUN TAKAYASU, and KAZUO INOUE (Tonen Corp., Corporate Research and Development Laboratory, Saitama, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 521-528. refs Copyright

The effect of interfacial strength on the tensile failure process of high modulus pitch-based CFRP was examined from a micromechanics viewpoint by using a single fiber-embedded specimen and a unidirectional strand specimen. The tensile failure process of the model specimen was simulated on the basis of an FEM analysis in which an interface between elements was expressed by normal and shear springs. A nonlinear FEM simulation was carried out on a single fiber-embedded specimen and compared with the model experiments. The numerical simulation gave a good estimation of the different critical fiber length depending on the different interfacial yielding stress. A dynamic FEM simulation was performed on a unidirectional strand specimen, which showed that the lower interfacial strength gave a higher tensile strength due to the difference in failure modes. Author

A92-23158

NOVEL METHODS TO STUDY THE DEFORMATION BEHAVIOR OF COMPOSITE INTERPHASE

NORIO SATO, TOSHIO KURAUCHI, and OSAMI KAMIGAITO (Toyota Central Research and Development Laboratories, Inc., Aichi, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on

Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 559-566. refs
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The deformation of the interphase in a composite is investigated by means of in situ SEM observations, acoustic emission measurements, high-stress dynamic viscoelastic measurements, and thermoacoustic emission measurements. The unique experimental set-ups are delineated, and illustrations and data are given on the microdeformation and other behaviors. The composite is a sheet-molding compound which is studied with SEM and acoustic emission to examine microfailure and deformation behavior while under load. The viscoelastic measurements provide data on the energy-dissipation mechanism of the interphase, and the thermoacoustic data describe the deformation due to thermal stress. The methods are concluded to be useful for the application, and the data suggest that the interphase strongly affects the fatigue properties of the composites. The latter conclusion is of interest to developing methods for controlling fatigue properties in aerospace composites by focussing on the interphase deformation. C.C.S.

A92-23171

CFRP/DAMPING-MATERIAL LAMINATES

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New materials, that possess high damping capability and have high strength property, have been studied in carbon fiber reinforced plastic (CFRP) materials. These materials are referred to in this paper as CFRP/damping-material laminates. CFRP/damping-materials were fabricated using thermoplastic based damping material with an autoclave curing technique. Cantilever beam tests revealed the high damping properties of these laminates. Loss factor values for these laminates are from 5 through 50 times as large as that for conventional CFRP. Tensile test results indicated that damping material interleaving has significant effects on both the tensile strength and the fracture mode. In three different kinds of laminates, the ultimate load showed an increase of roughly 4 percent in comparison with conventional CFRP. Author

A92-23190

PREPARATION OF HIGH-TEMPERATURE STRENGTH SiC FIBER

KIYOHITO OKAMURA (Osaka Prefecture, University, Sakai, Japan), MITSUHIKO SATO (Ube Industries, Ltd., Japan), TADAO SEGUCHI, and SHUNICHI KAWANISHI (Japan Atomic Energy Research Institute, Takasaki, Japan) IN: Controlled interphases in composite materials; Proceedings of the 3rd International Conference on Composite Interfaces (ICCI-III), Cleveland, OH, May 21-24, 1990. New York, Elsevier, 1990, p. 209-218. refs
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The tensile strength of Nicalon-type silicon carbide SiC(O) fiber drops quickly at heat treatment temperatures above 1573 K, and virtually zero at 1723 K. The decrease of the tensile strength is considered to be due to the oxygen introduced in the thermal oxidation curing process. In order to improve its high-temperature strength, it is necessary to reduce the oxygen content. The preparation of high-temperature resistant silicon carbide fiber was investigated using oxygen-free curing process (i.e., the radiation curing process). By heat treatment of radiation-cured polycarbosilane fibers, silicon carbide SiC(E) fibers with a small amount of oxygen were obtained. Then, by the combination of radiation-curing and annealing process, lesser oxygen-contained silicon carbide SiC(E/T) fibers were obtained, too. The high-tensile

strength of the SiC(E) or SiC(E/T) fibers was higher than that of SiC(O) fiber, at about 1773 K. The surface morphology of the SiC(E) or SiC(E/T) fibers after heat treatment at 1773 K was smooth, but that of SiC(O) was very rough. The relative concentrations of silicon, carbon, and oxygen of these fibers were qualitatively examined using scanning AES. Author

A92-23196

SURFACE MODIFICATION OF ALUMINUM-BORON DOUBLE OXIDE WHISKER AND ITS EFFECTS ON WHISKER/ALUMINUM OR WHISKER/THERMOPLASTIC COMPOSITE

TAKUO NAKATSUKA, HAJIME KAMBARA, and HAJIME HATA (Shikoku Chemicals Corp., Marugame, Japan) IN: Controlled interphases in composite materials; Proceedings of the 3rd International Conference on Composite Interfaces (ICCI-III), Cleveland, OH, May 21-24, 1990. New York, Elsevier, 1990, p. 335-342. refs
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Recently aluminum boron double oxide whiskers, having a chemical formula of $9Al_2O_3 \cdot 2B_2O_3$ and a crystal structure of orthorhombic, have been produced. The whiskers are stable in the air up to 1050 C. Reinforcing effects of the original and silane-modified whiskers on thermoplastics are examined and compared by an equation of discontinuous-fiber reinforcing theory including a parameter to express a difference of matrix modulus. When compounded with aluminum, the whiskers decompose and gamma-alumina is produced. Zirconium oxide or tantalum oxide coatings reduce the whisker decomposition and improve mechanical properties of the composites. Author

A92-23215

DYNAMIC VISCOELASTIC PROPERTIES OF A UNIAXIALLY ALIGNED CARBON FIBER REINFORCED EPOXY RESIN

SHOAKI IDE (Kobe Steel, Ltd., Polymers and Composites Development Center, Japan), TOMOJI TAKAHASHI (Kobe Steel Europe, Ltd., Research Laboratory, Surrey, England), and AKIRA SHIMAMOTO (Kobe Steel, Ltd., Polymers and Composites Development Center, Japan) IN: Controlled interphases in composite materials; Proceedings of the 3rd International Conference on Composite Interfaces (ICCI-III), Cleveland, OH, May 21-24, 1990. New York, Elsevier, 1990, p. 701-706. refs
Copyright

Measurements were carried out to investigate the dynamic viscoelastic properties of uniaxially aligned CFRP composites containing a resin matrix composed of diglycidyl ether of bisphenol, nadic methyl anhydride, and an aromatic tertiary amine system. Special attention was given to measurements of the effects of the fiber volume fraction (V_f) and the angle between the longitudinal direction of the specimen and the fiber axis on the mechanical dispersion of uniaxially aligned carbon fibers (CFs). The following results were obtained: (1) new types of dispersion (b1- and b2-dispersions), other than the a-dispersion of the cured epoxy resin alone, were observed on the E-double-prime vs. temperature curves obtained upon the addition of CF yarn; (2) the relative intensity of the b1 and b2 dispersions varied with the fiber volume fraction, the intensity of the b1 dispersions becoming larger than that of the b2 dispersion with an increase of V_f ; and (3) the mechanical dispersion depended on the angle between the longitudinal direction of the specimen and the fiber axis. I.S.

A92-23282

FATIGUE PROPERTIES AND FATIGUE FRACTURE MECHANISMS OF SiC WHISKERS OR SiC PARTICULATE-REINFORCED ALUMINUM COMPOSITES

CHITOSHI MASUDA and YOSHIHISA TANAKA (National Research Institute for Metals, Tokyo, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, Jan. 15, 1992, p. 413-422. refs
Copyright

A rotating bending test has been used to ascertain the fatigue properties and fracture mechanisms of three Al-matrix composites reinforced by SiC whiskers (SiC-w) and particles (SiC-p). While SiC-p fatigue strength was somewhat higher than for the

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unreinforced reference material, that of SiC-w was 60 percent higher. Attention is given to differences between 2024 and 357 Al-alloy matrix behaviors. Mode I fatigue crack-initiation and propagation models are proposed for discontinuous fiber-reinforced Al-alloy composites; it is suggested that the SiC-w and SiC-p are especially consequential for fatigue crack initiation and propagation near the fatigue limit. O.C.

A92-24437

STRESS RELAXATION BY DISLOCATION PUNCHING TO RADIAL DIRECTION FROM A LONG FIBER IN A COMPOSITE
SHOICHI SHIBATA, T. MORI (Tokyo Institute of Technology, Yokohama, Japan), and MINORU TAYA (Washington, University, Seattle) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Feb. 1, 1992, p. 363-368. refs
Copyright

Radial dislocation punching, a relaxation process in a metal matrix composite, is investigated in the context of Eshelby's inclusion theory. The distribution of plastic strain after punching, the superposition of eigenstrains, the elastic state after punching, dissipation energy for punching, and punching distance are determined. By using the equivalent inclusion method, the analysis can be extended to the case where the elastic constants of an inclusion are different from those of the matrix. V.L.

A92-25144

SOME MECHANICAL PROPERTIES OF CARBON FIBRE-REINFORCED MAGNESIUM-MATRIX COMPOSITE FABRICATED BY SQUEEZE CASTING

Y. KAGAWA (Tokyo, University, Japan) and E. NAKATA (Composite Engineering Co., Ltd., Tokyo, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, Feb. 1, 1992, p. 176-178. refs
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Experimental results are presented for the mechanical properties of high-strength carbon fiber-reinforced pure Mg matrix composites fabricated by squeeze casting under optimum conditions. At temperatures below 473 K, the fracture surface was flat and there was no significant pullout from the Mg matrix; above that temperature, fiber-pullout was clearly in evidence at the fracture surface. Flexure strength decreased with increasing test temperature, due to insufficient fiber-to-matrix stress transfer as matrix shear yield stress is reduced. O.C.

A92-26772

ROTATIVE POLARIZATION SYSTEM OF MILLIMETRIC WAVE FOR DETECTING FIBER ORIENTATION IN CFRP

KEI URABE (Industrial Products Research Institute, Tsukuba, Japan) Journal of Reinforced Plastics and Composites (ISSN 0731-6844), vol. 11, Feb. 1992, p. 179-197. refs
Copyright

A new system for nondestructive and contact-free detection of fiber orientation in fiber reinforced composites such as CFRP was devised using 35 GHz millimetric wave. In this system, by rotating the polarization of the wave and compensating it after passing through the sample, changes of anisotropy caused by changes in fiber orientation of unidirectional CFRP or carbon fiber prepreg can be easily and efficiently checked. Scanning detection of fiber direction and of fiber misorientation are also possible with high sensitivity. Results of measurements with successful sensitivity are shown for several kinds of unidirectional samples with artificial fiber misorientations. Author

A92-27378

CORROSION RESISTANCE OF CARBON FIBER REINFORCED ALUMINUM ALLOY

HAJIME IKUNO, SHIN-ICHI TOWATA, FUSAYOSHI MIURA, KEN-ICHI SUZUKI, and SEN-ICHI YAMADA (Toyota Central Research and Development Laboratories, Inc., Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Feb. 1992, p. 98-104. In Japanese. refs

The corrosion resistance of hybrid FRM using carbon fibers with particulates and whiskers was investigated. Carbon

fiber-reinforced aluminum alloys (CFRMs) with few miniscus defects and little Al₄C₃ showed excellent corrosion resistance, while CFRM with many miniscus defects showed a much higher corrosion rate along the carbon fibers. C.D.

A92-27999

HIGH TEMPERATURE STRENGTH OF 6061 ALUMINUM ALLOY REINFORCED WITH BETA-PHASE SILICON NITRIDE WHISKER AND WHISKER/MATRIX INTERFACE MICROSTRUCTURE

KATSUAKI SUGANUMA, GENN SASAKI, TERUAKI FUJITA (National Defense Academy, Kanagawa, Japan), and MASAHIRO TOKUSE (Japan Ultra-High Temperature Materials Research Center, Yamaguchi) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Dec. 1991, p. 1358-1367. In Japanese. refs
Copyright

A high-temperature-strength 6061 aluminum-matrix composite reinforced with 13 vol pct beta-phase silicon nitride whisker was fabricated using a squeeze-casting method, and its mechanical properties were evaluated and compared with those of 6061 aluminum alloy. It was found that the strength of the composite above 300 C was quite good. Compared with the matrix value, the room temperature strength of the composite increased by about 20 percent; the elongation reached about 4 percent. Although no traces of severe reaction after squeeze casting were obvious, several nm thick crystalline layers were observed on the (100) plane of the whisker; the reaction layer was determined to be aluminum nitride. I.S.

A92-28987

EFFECTS OF ADDITIONS OF ZRC AND ZRB2 ON OXIDATION RESISTANCE OF C/SiC/B4C COMPOSITES

ICHIHITO OGAWA (Kyushu, Government Industrial Research Institute, Tosu, Japan) and TAKAYOSHI YAMAMOTO (Aso Cement Co., Ltd., Fukuoka, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, March 1, 1992, p. 296-298. refs
Copyright

An examination is conducted of the effects of ZrC and ZrB₂ additives on the oxidation resistance of C/SiC/B₄C composites with different SiC and B₄C proportions, over a range of oxidation temperatures. Composites with high SiC content and no additives showed a coarsely textured surface; those incorporating additives had smooth surfaces. It is suggested that the additives play a role in the increase of SiO₂ concentration in the protective film formed against oxidation at high temperature. This SiC does not, however, dissolve completely into the B₂O₃. O.C.

A92-29653

FATIGUE BEHAVIOR OF HIGH-STRENGTH POLYMERS AND GLASS-FIBER REINFORCED POLYMER COMPOSITES BASED ON DYNAMIC VISCOELASTIC MEASUREMENT DURING THE FATIGUE PROCESS

TISATO KAJIYAMA and ATSUSHI TAKAHARA (Kyushu University, Fukuoka, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 51, Sept. 1991, p. 163-177. refs

Fatigue behaviors of solid-state extruded high-density polyethylene (HDPE), gel-drawn ultrahigh molecular weight polyethylene (UHMWPE), and glass-fiber reinforced poly(butylene terephthalate) (PBT) were studied based on the dynamic viscoelastic measurements during the fatigue process. Fatigue behavior of extruded HDPE showed characteristic fatigue features depending on the type of cyclic straining. It was revealed that fatigue behavior of gel-drawn UHMWPE was sensitive to the crystalline relaxation characteristic. The fatigue performance of glass-fiber reinforced PBT was greatly improved by strengthening the interfacial adhesion between glass fiber and matrix PBT. A fatigue fracture criterion based on the magnitude of hysteresis energy loss consumed for a structural change was established for extruded HDPE and PBT-based composites. Author

A92-29661

EFFECTS OF THE PARTICLE DISTRIBUTION ON FATIGUE CRACK GROWTH IN PARTICULATE SiC/6061 ALUMINIUM ALLOY COMPOSITES

S. KUMAI, K. YOSHIDA, Y. HIGO, and S. NUNOMURA (Tokyo Institute of Technology, Yokohama, Japan) *International Journal of Fatigue* (ISSN 0142-1123), vol. 14, March 1992, p. 105-112. Research supported by MOESC. refs

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Fatigue-crack growth rates are examined in powder-metallurgy-processed 6061 aluminum alloy composites containing 15 and 30 wt. pct SiC particles with different particle distributions. Over the range $10 \exp^{-9}$ to $10 \exp^{-6}$ m/cycle the fatigue-crack growth rates in the composite materials were lower than those reported for the monolithic alloy. SEM observations of the broken specimens showed very few SiC particles on the fatigue surfaces produced at low values of ΔK . An increased area fraction of the fractured coarse particles was evident on the fatigue surfaces of the bimodal distribution composites tested at high ΔK . Quantitative examination of the crack-path profile was used to highlight the interaction between the particles and the crack path. The fatigue crack avoids SiC particles at low ΔK ranges, but at high ΔK ranges the crack appears to proceed by linking fractured SiC particles ahead of the main crack front.

Author

A92-32623

INFLUENCE OF SILANE COUPLING AGENTS ON INTERLAMINAR FRACTURE IN GLASS FIBER FABRIC REINFORCED UNSATURATED POLYESTER LAMINATES

Y. SUZUKI (Nitto Boseki Co., Ltd., Fukushima; Kyoto Institute of Technology, Japan), Z. MAEKAWA, H. HAMADA, A. YOKOYAMA, T. SUGIHARA (Kyoto Institute of Technology, Japan), and M. HOJO (Industrial Products Research Institute, Tsukuba, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 1-11. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 11-K-1 to 11-K-11. refs*

A92-32645

EXPERIMENTAL AND THEORETICAL STUDIES OF INJECTION MOULDING CONSIDERING THE UNSTABLE FLOW BEHAVIOUR

TSUNEO HIRAI, TSUTAO KATAYAMA (Doshisha University, Kyoto, Japan), MITOMO HIRAI (Osaka Prefectural College of Technology, Neyagawa, Japan), and KAZUHIKO KAGAWA (Mitsubishi Petrochemical Co., Ltd., Yokkaichi, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 15-C-1 to 15-C-9. refs*

The ununiform progress of the flow front during an injection moulding is investigated on a cup-shaped FRTP component. The ununiform flow behavior strongly influences the orientation of the reinforcement in FRTP products. This projecting part is assumed to be caused by the unstable flow behavior under the kinetic condition, and not by an unexpected mould condition. Therefore, the experiment is compared with the analysis taking the unstable flow state into consideration. The experimental results are well explained by this analytical results. Moreover, the numerical result on the orientation of the reinforcement shows it to be in good agreement with the experiment.

Author

A92-32655

MOISTURE EXPANSION OF GRAPHITE COMPOSITES

HISAYO SHIMODAIRA, TOSHIO ONO (Mitsubishi Electric Corp., Sagami Works, Sagamiara, Japan), and SHU YAMASHITA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Sagamiara, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 16-H-1 to 16-H-8. refs*

In order to elucidate moisture distortion of graphite composites, moisture weight gains and coefficients of moisture expansion of graphite fiber reinforced epoxy or PEEK composites were studied. The coefficients of moisture expansion of unidirectional and multidirectional laminates were measured in both longitudinal and transverse directions. Application of graphite composites to optical structures is discussed using these data.

Author

A92-32662

SAND EROSION BEHAVIOR OF GFRP

NOBUO HARA, KEN TSUDA (Tokyo Institute of Technology, Japan), and HIDEITSU HOJO (Nihon University, Narashino, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 16-O-1 to 16-O-8. refs*

Sand erosion tests were made with glass cloth/polyester composites and polyester resin by using the sand blasting type erosion tester in which the solid glass particle was accelerated by flowing air and impinged to the plate specimen. Impact velocity of particles was varied from 13 to 60 m/s and attack angle was varied from 20 to 90 deg. The change of weight loss with time at 90 deg of glass composites showed multierosion stages. In each stage, these composed two lines with different slopes. Lower slope was obtained in the period of matrix damage, and higher slope was of glass cloth. This behavior is different from that of homogeneous materials such as resins and metals. In volume erosion rate, at higher angle attack resin showed good resistance to erosion damage but at lower attack angle glass composites showed good resistance. The method to estimate the erosion rate of glass composite at 90 deg impact was proposed, and the calculated value agreed well with the experimental results.

Author

A92-32675

POWDER-FORGING OF SiC PARTICULATE REINFORCED ALUMINUM ALLOY COMPOSITES

HIROYUKI MORIMOTO, HIROSHI IWAMURA, and KEIJI JYONO (Kobe Steel, Ltd., Materials Research Laboratories, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 17-L-1 to 17-L-8. refs*

A process for forging a mixture of SiC particles and 2024 aluminum alloy powder is described which allows the direct forming of the powder mixture into a near-net shape. The powder mixture is first preliminary-forged at temperatures below 673 K to increase the density and then finish-forged at a temperature just below the solidus line. This process suppresses the oxidation of Mg and makes it possible to achieve 100-percent densification and obtain products with improved tensile strength characteristics.

V.L.

A92-32691

FOUR WETTING PHASES IN ALN/AL AND ALN+C/AL SYSTEMS

HIDETOSHI FUJII, HIDEO NAKAE, KOJI OKADA (Waseda University, Tokyo, Japan), and MASANORI OGUNI (Nippon Light Metal Co., Ltd., Shizuoka, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 19-B-1 to 19-B-8. refs*

The wetting characteristics of AlN and AlN+C with respect to molten aluminum were evaluated by an improved sessile drop method. For normal AlN (containing Y₂O₃ as a sintering agent), the contact angle is found to progress through the following four phases: dynamic nonequilibrium (I), quasi-equilibrium (II), chemical nonequilibrium (III), and equilibrium (IV). For purified AlN, however, only two phases, I and IV (or II) are observed. For AlN+C composites, the contact angle also progresses through four phases. An analysis of the results suggests that a decrease in the total

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energy of the system is the main factor responsible for a decrease in the contact angle. V.L.

A92-32693

MECHANICAL PROPERTIES OF ALUMINUM BORATE WHISKER REINFORCED ALUMINUM ALLOYS AND INTERFACE STRUCTURE

K. SUGANUMA, G. SASAKI, T. FUJITA (National Defense Academy, Yokosuka, Japan), and N. SUZUKI (Advanced Materials Technology, Numazu, Japan) IN: *Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 19-D-1 to 19-D-12. refs

Specimens of aluminum alloys reinforced by aluminum borate whiskers fabricated by squeeze casting were tested mechanically, and the fiber-matrix interface was examined by transmission electron microscopy. A comparison of the mechanical properties of 6061 alloy matrix composites reinforced with aluminum borate and other types (i.e., silicon carbide, silicon nitride, and potassium titanate) whiskers demonstrates the advantages of the new whiskers. The aluminum borate/aluminum composites have high strength at elevated temperatures, high Young's modulus, and low thermal expansion coefficient. The reaction between aluminum borate whiskers and aluminum alloy is not severe. A thin amorphous-like layer is formed at the whisker-matrix interface. V.L.

A92-32699

INFLUENCE OF REACTION ZONE THICKNESS ON TENSILE STRENGTH FOR TITANIUM-MATRIX COMPOSITES REINFORCED WITH SiC FIBER

TADAO ONZAWA, AKIO SUZUMURA, and JONG H. KIM (Tokyo Institute of Technology, Japan) IN: *Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 19-J-1 to 19-J-10. refs

The effect of the reaction-zone thickness on the tensile strength of SiC-fiber-reinforced composites with various Ti-containing matrices including a commercially pure Ti (CPTi), Ti-6Al-4V, and Ti-21V-4Al, was investigated. The major reaction products in the fiber-matrix interface were TiC and Ti₅Si₃. Results of SEM and TEM observations showed that the growth rate of the reaction zone in the composite with Ti-21V-4Al matrix was lower than in composites with CPTi and Ti-6Al-4V matrices. The tensile strength of composites decreased with increasing reaction-zone thickness, but only after the reaction zone thickness reached the value of 1 micron. I.S.

A92-32719

FUNDAMENTAL STUDY ON FABRICATION OF C/C ROD

TSUYOSHI OZAKI, MITSUHIRO OKUMURA, HIROYUKI TERAMOTO, and KIYOSHI YOSHIZAKI (Mitsubishi Electric Corp., Sagami Laboratory, Japan) IN: *Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 22-A-1 to 22-A-10. Research sponsored by New Energy and Industrial Technology Development Organization of Japan. refs

A new procedure for the fabrication of composite rods made of fibrous carbon substrates and pyrolytic carbon matrices is described. In this procedure, unidirectional C/C rods are fabricated first using the chemical vapor infiltration (CVI) procedure, and then the 2D or 3D skeleton frames are assembled and reinfilted. Results of SEM and optical polarizing microscopy showed that the microstructure of the final product was smooth laminar. The deposition rate and the area where the pyrolytic carbon was infiltrated depended strongly on the infiltration temperature and the process gas pressure. I.S.

A92-32721

FABRICATION OF 2-D PAN FIBER-PITCH MATRIX CARBON-CARBON COMPOSITES USING PREPREG TECHNIQUE

SHIGERU TAKANO (Kawasaki Steel Corp., High Technology Research Laboratories, Chiba, Japan; Southern Illinois University, Carbondale, IL), PAWEL TLOMAK (Southern Illinois University, Carbondale, IL), and CHENG-PING JU (National Cheng Kung University, Tainan, Republic of China) IN: *Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 22-C-1 to 22-C-11. refs

Two-dimensional PAN fiber-pitch matrix carbon-carbon composites have been successfully inhouse fabricated at Southern Illinois University at Carbondale using a prepreg technique. This technique involves mixing fiber weaves and fine pitch powder under certain conditions presented in this report. Process parameters, such as stabilization and carbonization conditions, are also examined. The emphasis of this research is on the oxidation stabilization process, which is a key step in the prevention of bloating of matrix pitch during carbonization. An oxidation temperature of 200 C has been found optimal for the pitches used in this study. Both polarized light microscopy and scanning Auger microprobe results have shown that matrix is much more susceptible to oxidation than the fibers. Author

A92-32731

Ni3Al MATRIX COMPOSITES REINFORCED WITH ALUMINA PARTICLE/FIBER

K. SUGANUMA, G. SASAKI, and T. FUJITA (National Defense Academy, Yokosuka, Japan) IN: *Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 23-E-1 to 23-E-11. refs

Ni₃Al matrix composites with alumina particles, with alumina short fibers, and with aluminum borate whiskers have been fabricated by the powder metallurgical method. Aluminum borate whisker reacts with the matrix elements during sintering to form fine alumina particle dispersion and a boron solution. Although the composite reinforced with 10 vol pct alumina fiber did not have good strength (670 MPa by bending), 10 vol pct alumina particle reinforcement increased strength up to 900 MPa. Alumina fine particles dispersed finely along grain boundaries and inside grains. Boron seems to have a role in increasing the toughness of the matrix. The highest strength was beyond 1.8 GPa by bending (900 MPa by tensile). No third phase was observed between alumina and the matrix. In all cases the interface between alumina and Ni₃Al showed no trace of reaction. Author

A92-32764

EVALUATION OF STABLE FRACTURE PHENOMENA IN FRP(SMC) USING SURFACE CRACK DENSITY

SATOSHI SOMIYA (Keio University, Yokohama, Japan) IN: *Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 27-G-1 to 27-G-10. refs

Stable fracture phenomena in FRP(SMC) have been investigated experimentally. The change of the fracture toughness value J and stable cracks growth due to increasing applied stress levels is studied using test pieces of the compact tension type. The fracture toughness value J(in) at beginning of a stable crack from the notch tip is measured by the method of the elastic-plastic fracture toughness test. And it is confirmed that the value J(in) can be determined by a new parameter 'Crack Density' that is calculated by quantity of the length and the number of surface cracks observed on the specimen and the 'the size of damage area' at the notch tip. Author

A92-32769

RESISTANCE TO TRANSVERSE TENSION OF UNIDIRECTIONAL COMMINGLED CF/PEEK COMPOSITE

HOGYU YOON, KIYOHISA TAKAHASHI (Nagoya Institute of Technology, Japan), and KUNIO TANAKAMARU (Sikibo, Ltd., Central Research Laboratory, Yokaichi, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 27-O-1 to 27-O-10. refs

Resistance to transverse tension of unidirectional carbon fiber/PEEK composites was examined by uniaxial tensile and cleavage tests. Three types of unidirectional CF/PEEK composites were fabricated from: (1) prepreg sheet, (2) plain weave cloth; warp:commingled yarn(1800d) of carbon fiber with PEEK fiber, weft:PEEK yarn(70d), and (3) 5-shaft sateen weave cloth, warp:carbon yarn(1800d), weft:PEEK yarn(900d). The initial Young's modulus and the breaking strength measured by the transverse tensile tests were the highest on the specimen (1). Those of the specimen (3) were the lowest because of the lack of the CF/PEEK interfacial adhesion. On the other hand, the mode I intralaminar fracture toughness estimated from the cleavage test was the highest on the specimen (2). The interfacial adhesion between the carbon fiber and PEEK resin was also investigated by the SEM observation of the fractured surface after the transverse tension. On specimen (2), the fracture surface was rough and irregular and the fibers were twisted. While, the fracture surface of specimen (1) was flat and smooth and the fibers were parallel to each other. It was concluded that the undulation and twist of the carbon fibers enhanced the fracture toughness of specimen (2). Author

A92-32806

EVALUATION OF INTERFACIAL DEBONDING AND FIBER PULL-OUT STRESSES OF SiC FIBER-REINFORCED GLASSES

HIROSHI TSUDA, MANABU ENOKI, and TERUO KISHI (Tokyo, University, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 29-N-1 to 29-N-7. refs

Interfacial behavior of SiC fiber reinforced glass matrix composites was analyzed by a single fiber pull-out testing. The interfacial properties of this composite were calculated by using Hsueh's shear-lag analysis during the fiber pull-out tests in terms of interfacial shear strength, coefficient of friction and residual clamping stress. Experimental difference of load-time curves between materials can be explained by the analysis of shear stress distribution of fiber. Author

A92-32808

ELECTRICAL CONDUCTIVITY OF SHORT CARBON FIBER FILLED POLYMER COMPOSITES

YOSHIHIRO SAKAMOTO, HISAO TAKEUCHI, SIGEKI TOMONOH, and TAKEO SAWANOBORI (Mitsubishi Kasei Corp., Research Center, Yokohama, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 29-P-1 to 29-P-10. refs

The electrical conductivity of injection-molded short-carbon-fiber-filled polymer composites was studied. The effects of fiber dimension and volume fraction were analyzed with percolation theory and the scaling rule. For estimating the percolation threshold of fiber volume fraction, 3D computer simulations were carried out. The introduction of an imaginary shell on each fiber in the simulation decreased the discrepancy between the estimated threshold volume fraction and the experimental volume fraction at the critical point of conductivity, V_c . As predicted by the simulation, the critical volume fraction was experimentally found to be dominated by the aspect ratio of the fibers. Two parameters in the scaling rule equation, VC and

intrinsic resistivity, were shown to be useful in evaluating the conductivity of the system. Author

A92-32845

TIME-TEMPERATURE DEPENDENCE ON FLEXURAL STRENGTH OF PITCH-BASED CARBON FIBER UNIDIRECTIONAL CFRP LAMINATES

MICHIHIRO MOHRI (Nippon Oil Co., Ltd., Central Technical Research Laboratory, Yokohama, Japan), YASUSHI MIYANO, and MEGUMU SUZUKI (Kanazawa Institute of Technology, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 33-B-1 to 33-B-9. Previously cited in issue 13, p. 2111, Accession no. A91-33220. refs

A92-32851

MECHANICAL PROPERTIES FOR CFRP/DAMPING-MATERIAL LAMINATES

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CFRP/damping-material laminates investigated here are composed of the unidirectional carbon/epoxy prepreg sheet and polyethylene based damping material sheet used as an interleaf. Cantilever beam tests revealed the high damping properties of these laminates. Loss factor values for these composites are from 5 through 50 times as large as that for conventional CFRP. These values could be predicted by using the analysis constrained layer damping treatment except for two specimens. The interleaving effect on tensile strength is also discussed. Tensile test results for quasi-isotropic laminates based composites indicated that the damping material interleaf is effective for suppressing delamination and multiple splitting in the 0 deg angle layer. A 3 through 8 percent ultimate load increase was caused by this suppression effect. Author

A92-32875

BIAXIAL TESTING OF COMPOSITE LAMINATES USING CRUCIFORM SPECIMENS

IPPEI SUSUKI (National Aerospace Laboratory, Chofu, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 37-A-1 to 37-A-9. refs

An attempt of developing a biaxial testing system for composite laminates was reported in this paper. The testing machine, composed of four hydraulic actuators, enabled independent in-plane biaxial static or fatigue loadings by the load/displacement feedback control system. The designing cruciform type specimens were studied to obtain desired biaxial stress states in the central area under biaxial loadings. The central region which makes the gauge area is consisted of a reduced section of uniform thickness, and connected by transition surroundings to the full thickness of the arms in order to avoid premature failures in these areas. A 2D finite element method with pre- and post-processors was prepared for designing configurations, stress strain analysis, and strength calculation of cruciform specimens. Laminates used in this study are (0/45/0/-45)s symmetric three-directional laminates of graphite/epoxy, graphite/PEEK and glass/epoxy composites. Preliminary experiments show that the damage extension ratio in the laminate during biaxial fatigue test is much faster under out-of-phase loading conditions than that of in-phase loading condition. Author

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A92-32882

INFLUENCE OF THERMAL CYCLING ON COMPRESSIVE FATIGUE PROPERTIES OF QUASI-ISOTROPIC CARBON/EPOXY LAMINATES

TOSHIO TANIMOTO and TOHRU MORII (Shonan Institute of Technology, Fujisawa, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 38-H-1 to 38-H-9. refs

Consideration is given to the compressive fatigue behavior of a quasi-isotropic laminate with a stacking sequence of (0/+ or -45/90)s. A compression fatigue test was performed with an electro-hydraulic fatigue testing machine at a frequency of 10 Hz. Comparisons of fatigue strength as well as compression fatigue, tension fatigue, and repeated tension and compression fatigue are made. A master diagram showing the relationship between stress amplitude and mean stress for a given number of fatigue cycles is presented. The effect of thermal cycling on compressive fatigue lives is discussed. The fixed value of the lower temperature to be applied on the specimen in the thermal cycling test was -55 C, while the higher temperature was 125 C. Thermal cycling does not always cause the compressive fatigue properties to deteriorate, but in some cases fatigue strength was improved by moderate thermal cycling. P.D.

A92-32897

SUPERPLASTIC BEHAVIOR IN AS-EXTRUDED AL-CU-MG ALLOY MATRIX COMPOSITE REINFORCED WITH 20 VOL PCT Si3N4 PARTICULATES

M. MABUCHI (Government Industrial Research Institute, Nagoya, Japan), K. HIGASHI, S. WADA, and S. TANIMURA (Osaka Prefecture University, Sakai, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, April 15, 1992, p. 1269-1274. refs

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High strain rate superplasticity has been found in a new 20 vol pct Si3N4p/Al-Cu-Mg composite. The composite developed to be a finite-grained structure 3 micron in size with a very uniform distribution of Si3N4 particulates of less than 1 micron in size, fabricated by hot extrusion at 733 K with a reduction ratio of 100:1. The maximum elongation of 830 percent, which has not been previously recorded for any finite-grained superplastic composites, was recorded at 788 K at a relatively high strain rate of 0.04/s at which a relatively high m value of about 0.3 was obtained. C.D.

A92-33126

CONSTITUTIVE RELATIONS OF HYBRID FIBER REINFORCED PLASTICS OF GFRP/CFRP AND GFRP/AFRP UNDER COMBINED STRESS STATE

KOZO Ikegami and MATSUO YOSHIDA (Tokyo Institute of Technology, Yokohama, Japan) IN: Inelastic deformation of composite materials; Proceedings of the IUTAM Symposium, Troy, NY, May 29-June 1, 1990. New York, Springer-Verlag, 1991, p. 623-638. refs

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The stress-strain relations of hybrid reinforced plastics are experimentally determined by subjecting filament wound tubes with various material constitutions to axial load, torsion, and internal pressure. The testing materials are hybrid reinforced plastics involving two combinations of glass fiber, carbon fiber, and aramid fiber reinforced plastics. The stress-strain curves of constituent reinforced plastics are formulated by using the third-order equations of stress components. The stress-strain relations of hybrid reinforced plastics are derived from the relations of constituent reinforced plastics on the assumption of perfect bonding between two layers of the constituent reinforced plastics. The stress-strain curves calculated by obtained relations represent the characteristic behavior of experimental curves under combined stress states as well as uniaxial stress state. Author

A92-33529

FATIGUE CRACK PROPAGATION BEHAVIOR OF NICKEL-FOAM REINFORCED ALUMINUM ALLOY

KAZUAKI SHIOZAWA, SEIICHI NISHINO (Toyama University, Japan), TAKASHI MIZUGUCHI (Toyama Murata Co., Ltd., Japan), RYUUICHI YOSHIKAWA, and TATSUYA YAGUCHI (Toyama University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, Feb. 1992, p. 246-252. In Japanese. refs

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A study focusing on the clarification of fatigue crack propagation behavior of nickel-foam reinforced aluminum alloy (NFRA) is presented. NFRA is investigated utilizing compact tension specimens under a testing frequency of 10 Hz in air and stress ratio of 0.05, 0.5, and 0.7. The crack propagation rate was affected by the size and shape of nickel-foam. Acceleration and retardation of propagation rate was observed around the Ni-skeleton due to propagation along the Ni-foam/matrix interface and in Ni-foam.

R.E.P.

A92-33897

PRODUCTION OF ULTRAFINE ALUMINUM AND ALUMINUM NITRIDE PARTICLES BY PLASMA-MOLTO REACTION AND THEIR MICROSTRUCTURE AND MORPHOLOGY

A. INOUE, B. G. KIM, K. NOSAKI, T. YAMAGUCHI, and T. MASUMOTO (Tohoku University, Sendai, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, April 15, 1992, p. 4025-4029. refs

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Conditions necessary for preparing ultrafine Al and AlN particles by the plasma-molten Al reaction method were investigated. It was found that ultrafine Al and AlN particles could be produced by this method by controlling the volume ratio of AlN to Al in the range below 25 percent by changing the mixing ratio of N2 to Ar and the total pressure of nitrogen. The isolated Al particles have a spherical shape with a diameter between 50 and 200 nm, while the Al particles have a hexagonal-plate shape with a size of 40 to 120 nm and a thickness of 15 to 35 nm. Bright-field electrographs revealed presence of composite particles consisting of AlN phase embedded in Al phase; in these particles, the Al and AlN phases had a close orientation relationship so as to reduce the lattice misfit. I.S.

A92-34697

PROCESSING OF TiAl-Ti2AlN COMPOSITES AND THEIR COMPRESSIVE PROPERTIES

H. MABUCHI, H. TSUDA, Y. NAKAYAMA (Osaka Prefecture University, Sakai, Japan), and E. SUKEDAI (Okayama University of Science, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, April 1992, p. 894-900. Research supported by Light Metals Educational Foundation. refs

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Using elemental powders, combustion reaction was carried out to form intermetallic-ceramic composites in the Ti-Al-N system. Ti and Al powders reacted exothermically in gaseous nitrogen and formed a mixture product which had a fine distribution of the Ti2AlN particles in the matrix TiAl with a small amount of Ti3Al. Subsequently, these reacted products were arc-melted to obtain fully dense button ingots. The resulting composites had about 30 vol pct Ti2AlN, and the Ti2AlN particles were ellipsoidal or columnar in shape with sizes of 2-10 microns and appeared to be homogeneously distributed and well bounded to the matrix TiAl. It was found that such composite materials have a high strength at both room and elevated temperatures and some intrinsic compressive ductility at room temperature. Author

A92-36293

MECHANICAL PROPERTIES AND MICROSTRUCTURE OF BETA-SIALON-BETA-SiC COMPOSITES BY PRESSURELESS SINTERING

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Laboratory, Tokyo, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 7, April 1, 1992, p. 1908-1912. refs
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Beta-SiAlON-beta-SiC composites containing up to 12 wt pct beta-SiC were prepared by pressureless sintering. The strength of composites at room temperature remained relatively unchanged, whereas strength at 1200 C increased for composites. The fracture toughness K_{Ic} for composites was higher than that for beta-SiAlON ceramics. The maximum value was 5.4 MPa sq rt m for 6 wt pct beta-SiC, and this was an improvement of 15 percent in comparison with beta-SiAlON ceramics. From SEM observations, an improvement in K_{Ic} values was attributed to crack deflections and branching-off of cracks. Intragranular fractures were frequently observed in beta-SiAlON. From TEM observations, beta-SiAlON crystals were nanocomposites, within which existed the fine crystals in beta-SiAlON crystal. For composite, beta-SiAlON and beta-SiC crystals were directly in contact. The mismatching zone was observed in beta-SiC. Author

A92-37057

A STUDY ON A MATERIAL DESIGN FOR FLEXURAL BEHAVIOR OF CARBON/ARAMID HYBRID FRP LAMINATES
MASAYUKI NAKADA, YASUSHI MIYANO, MEGUMU SUZUKI, and YOICHI HATTORI (Kanazawa Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 462, March 1992, p. 349-355. In Japanese. refs
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Results are reported from an investigation of a material design guideline for the flexural behavior of carbon/aramid hybrid unidirectional FRP laminates studied from the standpoint of laminate constitution and time-temperature dependence. The flexural behavior under static, impact, and cyclic loads changed remarkably with laminate constitution, time or temperature, and the flexural fracture patterns were classified clearly into two modes according to laminate constitution and time-temperature dependence. Deformation and failure criteria which are applicable to the material design of these laminates are proposed. P.D.

A92-37058

THE RELATION BETWEEN HIGH TEMPERATURE ILSS OF CFRP WITH THERMOSTABLE RESIN MATRIX AND THE RESIN PROPERTIES

KAZUHIRO FUJITA and YOICHIRO NAKANISHI (Osaka, Government Industrial Research Institute, Ikeda, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 462, March 1992, p. 356-361. In Japanese. refs
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A short beam method of three-point bending is used to measure ILSS of seven kinds of CFRPs whose matrices were thermostable resins, including newly developed ones, in the temperature range between room temperature and 250 C; the relation with resin properties is also examined. Failed mode at high temperatures is also investigated on the basis of observations of the side surface of the specimen whose ILSS was tested. Two types of temperature dependent curves of ILSS were found. ILSS decreased linearly with increasing temperature in one type. In the other type, the degree of ILSS decrease became larger with increasing temperature, and the ILSS-temperature relation did not follow a linear line but a bent curve. P.D.

A92-37059

DELAMINATION FATIGUE CRACK PROPAGATION BEHAVIOR OF CFRP LAMINATES WITH TWO KINDS OF CF AND EPOXY
HIDEKI SEMBOKUYA (Takushoku University, Hachioji, Japan), MASAKI HOJO, KIYOSHI KEMMOCHI (Agency of Industrial Science and Technology, Industrial Products Research Institute, Tsukuba, Japan), HIROSHI MAKI (Takushoku University, Hachioji, Japan), and ZENICHIRO MAEKAWA (Kyoto Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 462, March 1992, p. 375-381. In Japanese. refs
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The paper investigates delamination fatigue crack propagation

behavior for four kinds of CF/epoxy laminates. The effect of reinforcing fiber on the delamination fatigue crack growth behavior was very small. The analysis of the equivalent stress intensity range proposed indicated that the contribution of the maximum load to the delamination fatigue crack propagation of the laminates tested was large. P.D.

A92-37060

IMPACT DAMAGE ANALYSIS OF ARAMID/GLASS HYBRID LAMINATES

TOSHIMITSU OHGAMI (Toto, Ltd., Chigasaki, Japan), ISAO KIMPARA, KAZURO KAGEYAMA, TOSHIO SUZUKI, and ISAMU OHSAWA (Tokyo, University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 462, March 1992, p. 382-388. In Japanese. refs
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A numerical method for analyzing the dynamic strength of aramid/glass hybrid laminates is proposed and applied to estimate their multiaxial impact strength. The progressive fracture process under impact loading was well simulated and the numerical results showed close agreement with the experimental data, which exhibit brittle fracture. The fracture controlling process of mat/roving-cloth reinforced laminates is also discussed quantitatively on the basis of the present analysis. P.D.

A92-37810

FABRICATION OF HYBRID COMPOSITES BY LAMINATION OF FIBER REINFORCED ALUMINUM AND PARTICLE DISPERSED ALUMINUM ALLOY, AND ITS STRENGTH AND WEAR RESISTANCE

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A fabrication process employing hot pressing to produce hybrid composites was established. Both tensile strength and wear resistance of the fabricated hybrid composites are found to be superior. The obtained tensile strength of the hybrid composites agrees with that calculated using the rule of mixture, and the abrasive wear resistance of the hybrid composites is improved by dispersing SiC particles in the aluminum alloy and conducting a heat treatment (T6). Author

A92-37811

WETTABILITY BETWEEN SiC FIBRES AND LIQUID ALUMINUM ALLOYS

HIROMICHI NAKATA, TAKAO CHOH, and SHINGO NAKAMURA (Nagoya University, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 3, March 1992, p. 155-160. In Japanese. refs
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The wettability of SiC fibers to molten aluminum was investigated by a dip-coverage method, and was compared with previous results of that of SiC block. At higher temperatures around 1273 K, the coverage ratio of SiC fibers by pure aluminum is less than that of SiC block, since the rate constant of overall reaction $k(0)$ is distinctly lower and the incubation time τ is longer. However, alloying of Ti, Hf and V, increases $k(0)$ and shortens τ for SiC fibers. In this case, those values are as much as the level of SiC block. These adverse results can be explained by considering Wenzel's equation which expresses the effect of roughness of solid/liquid interface on the wettability. At a lower temperature of 1023 K, addition of Ca or Ca with Mg improves the wettability between SiC block and liquid aluminum. When SiC short fibers were incorporated into Al-Mg-Ca alloy at 1073 K, the distribution of SiC short fibers was more uniform than that in Al-Mg alloy. Hence, the simultaneous addition of Ca and Mg obviously contributes to the good wettability of SiC fibers to liquid aluminum, too. Author

24 COMPOSITE MATERIALS

A92-39619

MATRIX GRAIN SIZE EFFECT AND FRACTURE BEHAVIOR ON BENDING STRENGTH AND FRACTURE TOUGHNESS IN MULTI-TOUGHENED AL2O3

K. IKEDA and T. KISHI (Tokyo, University, Japan) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 7-8, July-Aug. 1992, p. 164-171. Research supported by Japan Society for the Promotion of Science. refs
Copyright

Al₂O₃ was reinforced with SiC-whisker and SiC-platelet as model material for multitoughening effect. All materials were fabricated by same procedure to neglect the effect of process difference. Grain size distribution was strongly affected by the shape and mass fraction of reinforcement, and the distribution changed fracture style in fracture surface. It was found that bending strength can be evaluated by Petch's law as first-order approximation. Compared with single-toughening composites, fracture toughness was highly improved in multitoughening composite. Deflection by platelet improved fracture toughness in case of fine matrix grain composites, and no interaction between whisker and platelet was observed. Author

A92-39654

PREPARATION OF CARBON FIBER REINFORCED COMPOSITE BY IMPREGNATION WITH PERHYDROPOLYSILAZANE FOLLOWED BY PRESSURELESS FIRING

K. SATO, T. SUZUKI, O. FUNAYAMA, T. ISODA (Tonen Corp., Saitama, Japan), and T. ITOH (Petroleum Energy Center, Tokyo, Japan) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 9-10, Sept.-Oct. 1992, p. 614-621. refs
Copyright

Filament wound carbon fiber/Si-N and carbon fiber/SiC whisker/Si-N composites with a density close to the theoretical limit (90-96 percent) were produced by using low-viscosity polysilazane with high ceramic yields as a matrix precursor. The composites showed good flexural strength at high temperatures. The use of dispersed SiC whiskers produced a flexural strength of 695 MPa. The fabrication method described here does not require high pressure in firing and has potential for a near-net-shape process. V.L.

A92-39927

FABRICATION AND MECHANICAL PROPERTIES OF ZN-22 MASS PCT AL SUPERPLASTIC ALLOY COMPOSITES REINFORCED BY SiC WHISKER

JUN S. KIM, JUNICHI KANEKO, and MAKOTO SUGAMATA (Nihon University, Narashino, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, no. 9, Sept. 1991, p. 986-993. In Japanese. refs
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SiC whisker reinforced composites with Zn-22Al alloy matrix were fabricated by high pressure infiltration of the alloy melt and hot extrusion of the composite ingots eutectoid heat-treated to produce superplastic fine grain structures. Structures and mechanical properties at room temperature were examined on the obtained composites. The composites were shown to be hot-extruded under lower extrusion pressure than aluminum alloys such as 2024 and 7075. Less damage of whiskers during hot extrusion and hence a higher strengthening effect of whiskers than the composites with aluminum alloy matrix were observed. The elastic modulus and tensile strength of the V_f 20 percent composites at room temperature were 152 GPa and 488 MPa, respectively. Author

A92-39928

DEFORMATION OF SiC WHISKER/ZN-22 MASS PCT AL SUPERPLASTIC ALLOY COMPOSITES AT ELEVATED TEMPERATURES

JUN S. KIM, MAKOTO SUGAMATA, and JUNICHI KANEKO (Nihon University, Narashino, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, no. 9, Sept. 1991, p. 994-1001. In

Japanese. refs

Copyright

Deformation behavior at elevated temperatures is examined under various conditions for SiC whisker-reinforced composites with Zn-22Al alloy matrix fabricated by high-pressure infiltration and subsequent hot extrusion. Hot compressive forming of the composite ingots into variously shaped parts was carried out by using closed dies. Superplasticity was not observed for the composites, but the Zn-22Al matrix alloy showed tensile elongation as high as 1200 percent at 553 K. Formation of voids in the composites was revealed by metallographic inspection of the elongated specimens. The existence of SiC whiskers as the reinforcement was shown to significantly affect the deformation and fracture behavior of the composites at elevated temperatures. The strain rate exponent of the composites decreased with an increase of the whisker volume fraction. The elongation values obtained were shown to be high enough so that hot forming could be carried out. S.A.V.

A92-40533

MEASUREMENT OF INTERFACIAL SHEAR STRENGTHS IN SiC(CVD) FIBER-REINFORCED Ti-15Mo-5Zr-3Al COMPOSITE BY PUSH-OUT TECHNIQUE

YUTAKA KAGAWA and AKIMITSU OKURA (Tokyo, University, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 3, March 1992, p. 278-284. In Japanese. refs
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A push-out technique for thin specimens has been developed for measuring interfacial shear debonding and sliding strength in fiber-reinforced metal matrix composites. An experimental set-up for measuring the load-displacement relation of the fiber during push-down of the fiber axis is developed. An analytical form for obtaining interfacial shear strengths based on shear-lag analysis using the load-displacement relation is also developed. Both the test equipment and analytical procedure are applied to the measurement of interfacial shear strengths in a SiC(CVD) fiber-reinforced Ti-15Mo-5Zr-3Al matrix composite. The fiber axial load-displacement relation during the push-down of the composite sample is successfully obtained, and the interfacial shear strengths are calculated using this relation and the developed analytical procedure. S.A.V.

A92-40535

REACTIVITY OF POTASSIUM TITANATE WHISKERS WITH AL ALLOYS

ISAO TSUCHITORI (Hiroshima Prefecture West, Industrial Research Institute, Kure, Japan) and HIDEHARU FUKUNAGA (Hiroshima University, Higashihiroshima, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 3, March 1992, p. 333-341. In Japanese. refs
Copyright

The reactivity of the improved potassium titanate whisker with aluminum alloys was investigated by differential thermal analysis (DTA) by using their composites which was fabricated by squeeze casting in low-temperature processing. It was found that the exothermic reaction occurred at two different temperatures by DTA, that is, at near 883 K and at 1223 K. The reaction at the lower temperature was not affected by the elements in the matrix Al alloys. After heat treatment of 883 K-1 h for stimulation, the surface of extracted whisker from the composite was covered with particulated reactants which were considered as alpha-Al₂O₃. The apparent activation energy of the reaction at near 883 K was calculated about 277 kJ/mol from DTA data. On the other hand, the reaction at the higher temperature was affected by the elements in the matrix Al alloys, and the reactants on the whisker surface identified as Al₃Ti and alpha-Al₂O₃. In the case of matrix Al alloys containing Mg, the DTA found the exothermic reaction undefined, and the fan shaped reactant was observed on the whisker surface extracted from the composites after heat treatment of 883 K-1 h. Author

A92-41105

MICROCRACKING DURING A THERMAL CYCLE IN WHISKER-REINFORCED CERAMICS COMPOSITES DETECTED BY ACOUSTIC EMISSION MEASUREMENT

N. SATO and T. KURAUCHI (Toyota Central Research and Development Laboratories, Inc., Aichi, Japan) *Journal of Materials Science Letters* (ISSN 0261-8028), vol. 11, no. 9, May 1, 1992, p. 590, 591. refs

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A92-41106

DETECTION OF MICROCRACKING IN MANUFACTURING CONTINUOUS FIBRE-REINFORCED ALUMINIUM COMPOSITES BY ACOUSTIC EMISSION MEASUREMENT

N. SATO and T. KURAUCHI (Toyota Central Research and Development Laboratories, Inc., Aichi, Japan) *Journal of Materials Science Letters* (ISSN 0261-8028), vol. 11, no. 9, May 1, 1992, p. 598-600. refs

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A92-41566

EXPERIMENTAL INVESTIGATION OF SUPERPLASTIC BEHAVIOR IN A 20 VOL PCT Si3N4P/5052 ALUMINUM COMPOSITE

M. MABUCHI (Government Industrial Research Institute, Nagoya, Japan), K. HIGASHI, K. INOUE, and S. TANIMURA (Osaka Prefecture University, Sakai, Japan) *Scripta Metallurgica et Materialia* (ISSN 0956-716X), vol. 26, no. 12, June 15, 1992, p. 1839-1844. refs

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Evidence is presented on the development of superplastic properties in a 20 vol pct Si3N4(p)/Al-Mg composite in which the matrix was Al-Mg alloy 5052 and the Si3N4 particulate inclusions were of less than 0.2 micron in size. The as-extruded Si3N4(p)/5052 aluminum composite was fabricated by hot extrusion at 763 K with a reduction ratio of 100:1. The superplastic behavior was determined using a constant true-strain-rate test carried out over a wide strain-rate range (0.001/sec to 300/sec) at an optimum superplastic temperature of 818 K in air. The maximum elongation of 700 percent was recorded at a strain rate of 1/sec at 818 K.

I.S.

A92-41782

INTERLAMINAR SHEAR STRENGTH OF FIBER REINFORCED PLASTICS

HIROO MIYAIRI and KAZUO TAKAKUDA (Tokyo Medical and Dental University, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 23-26. In Japanese. refs

The boundary strength of fiber reinforced plastics is presented. The boundary adhesive strength of carbon fiber reinforced plastics is discussed. The effects of environmental conditions such as room temperature, and dry and wet conditions are evaluated. Effects of moisture absorption on the interlaminar shear strength of fiber reinforced plastics are emphasized.

Y.P.Q.

A92-41783

INTERLAMINAR FRACTURE OF CFRP LAMINATES

TAKASHI KURIYAMA, IKUO NARISAWA (Yamagata University, Yonezawa, Japan), and TOSHIHIKO ABE (Government Industrial Research Institute, Tohoku, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 27-30. In Japanese.

Experimental tests on interlaminar fracture of carbon fiber reinforced plastic (CFRP) laminates are presented. The penetration damage at a low speed shock and internal damage detected by a scanning acoustic microscope are analyzed. The transverse crack of the CFRP is illustrated.

Y.P.Q.

A92-41975

BEHAVIOUR OF CARBON FIBRE REINFORCED AL-Si COMPOSITES AFTER THERMAL EXPOSURE

H. M. CHENG (Nagasaki University, Japan), S. AKIYAMA, A. KITAHARA (Kyushu, Government Industrial Research Institute, Saga, Japan), K. KOBAYASHI (Nagasaki University, Japan), and B. L. ZHOU (Chinese Academy of Sciences, Institute of Metal Research, Shenyang, People's Republic of China) *Materials Science and Technology* (ISSN 0267-0836), vol. 8, no. 3, March 1992, p. 275-281. Research supported by World Laboratory - International Centre for Scientific Culture and NNSFC. refs

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The behavior of high-modulus carbon-fiber-reinforced Al-Si composites after thermal exposure at 773 K for various times has been investigated. The composites were fabricated via hybridization of a small volume fraction of SiC particles using a pressure casting process. The longitudinal tensile strength (LTS) of the composites increased to a maximum of 899 MN/sq m when exposed for 216 h, then decreased as the exposure continued. The transverse tensile strength of the composites increased monotonically with increasing treatment time, suggesting that interfacial bond strength was improved by the thermal exposure. It was found that fiber pull-out played an important role in the LTS of the composites and that moderate fiber pull-out resulted in higher values of LTS. The results of single fiber tensile tests show that long term thermal exposure at 773 K only slightly degraded the fibers compared with the fibers in the as-cast composites. The fiber pull-out behavior and the microstructural observations of the fiber surfaces gave some evidence that chemical interactions occurred in the fiber/matrix interfaces.

Author

A92-42573

MECHANICAL PROPERTIES OF AIR-ANNEALED SiC PARTICLE/AL2O3 COMPOSITE

Y. AKIMUNE, Y. KATANO, T. AKIBA, and T. OGASAWARA (Nissan Motor Co., Ltd., Materials Research Laboratory, Yokosuka, Japan) *Journal of Materials Science Letters* (ISSN 0261-8028), vol. 11, no. 10, May 15, 1992, p. 695-697. refs

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XRD and SEM analyses were conducted on an SiC particle-reinforced Al2O3 composite before and after air annealing. While the room-temperature strength, Weibull modulus and fracture toughness of this composite were significantly higher than corresponding values for monolithic ceramics, the air-annealing process produced mulite on specimen surfaces, with associated strength degradation.

O.C.

A92-43232

NEW COMPOSITE MATERIAL DEVELOPMENT FOR AEROSPACE

AKIRA KOBAYASHI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 592-595. In Japanese. refs

Trends in the utilization of advanced composite materials, such as glass-fiber-reinforced plastics (GFRP), are presented. The increasing demand for aluminum and lithium alloys is discussed, and research on heat-resistant materials is described.

Y.P.Q.

A92-43236

THE FORMING CONDITIONS OF CF/PEEK

MINORU NODA, Y. ITO, SHINICHI MIYAMOTO, and SHIGERU HIBINO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 608-611. In Japanese. refs

The thermal and hot/wet resistance characteristics of CF/PEEK composite materials are presented. Differential scanning calorimetry analysis is discussed, and the relationship between cooling speed and compression strength is analyzed.

Y.P.Q.

24 COMPOSITE MATERIALS

A92-43237

THERMAL FIBER-REINFORCED-PLASTIC COMPOSITE TECHNOLOGY FOR AIRCRAFT STRUCTURES

T. NAGAMO, HIROKA NAKAMURA (Fuji Heavy Industries, Ltd., Tokyo, Japan), TOSHIYUKI NAKAKURA, and HIDEO SAKAI (Mitsui Toatsu Chemicals, Inc., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 612-615. In Japanese. refs

Thermal composite technology for a Mach 2.5 supersonic aircraft is presented. The basic properties of the PIX composite material and the formation technology are discussed and filament winding formation is addressed. Various kinds of adhesive methods for composite materials are described. Y.P.Q.

A92-43615

HARDNESS CHARACTERISTICS IN AGED PARTICULATE SiC/A356 CAST ALUMINUM ALLOY COMPOSITES

S. KUMAI, J. HU, Y. HIGO, and S. NUNOMURA (Tokyo Institute of Technology, Yokohama, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 27, no. 1, July 1, 1992, p. 107-110. Research supported by Iketani Science and Technology Foundation. refs

Copyright

An analysis is conducted of the hardening characteristics of a particulate SiC/A356 Al-alloy composite, giving attention both to the matrix alloy hardness behavior within the alpha-dendrite cell and the microstructure to which the SiC particulate contributes. Two different aging heat treatments were used. Room-temperature aging for 24 hrs, followed by isothermal aging at 160 C, yields matrix-aging conditions that are comparable for both control and composite materials after about 20 hrs. When room-temperature aging is not used, only the composite reaches the peak aging condition in the same aging period. O.C.

A92-44455

MECHANICAL BEHAVIOR AND FRACTURE MECHANISM IN FLAT BRAIDED COMPOSITES. I - BRAIDED FLAT BAR. II - BRAIDED FLAT BAR WITH A CIRCULAR HOLE

AKIHIRO FUJITA, ZENICHIRO MAEKAWA, HIROYUKI HAMADA, and ATSUSHI YOKOYAMA (Kyoto Institute of Technology, Japan) Journal of Reinforced Plastics and Composites (ISSN 0731-6844), vol. 11, no. 6, June 1992, p. 600-632. refs

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A92-44658

TIME-TEMPERATURE DEPENDENCES OF MECHANICAL PROPERTIES OF HIGH TEMPERATURE EPOXY RESIN AND CFRP LAMINATES USING THE RESIN

MASATO KASAMORI, TAKERU OHTSUKA, MINORU SHIMBO, and YASUSHI MIYANO (Kanazawa Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 463, April 1992, p. 465-469. In Japanese. refs

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This paper is concerned with the time and temperature dependences of the static flexural behavior in CFRP laminates consisting of high-temperature epoxy matrix and satin woven carbon fibers. Dynamic viscoelastic tests for neat resin and three-point bending tests for CFRP laminates were carried out under various loading rates and temperatures. The results obtained are summarized as follows: (1) the mechanical behavior of epoxy resin used was remarkably dependent upon time and temperature even in the vicinity of room temperature that is sufficiently lower than the glass transition temperature T_g , (2) the static flexural strength of CFRP laminates was also remarkably dependent upon time and temperature over a wide range of temperature even below T_g , and (3) the time and temperature dependences of the static flexural strength of CFRP laminates was dominated by the mechanical behavior of matrix resin. Author

A92-45411

DEVELOPMENT OF HIGH PERFORMANCE CARBON-CARBON COMPOSITE BY PULSE CHEMICAL VAPOR INFILTRATION TECHNIQUE

JUN GOTOH, HIROTOSHI NAKAYAMA, MAMORU IMUTA, AKIHITO SAKAI, and NAOKI KITAMORI (Kawasaki Heavy Industries, Ltd., Gifu Technical Institute, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 413-420. Research supported by New Energy and Industrial Technology Development Organization of Japan. refs (SAE PAPER 912011) Copyright

To develop high performance carbon-carbon composite, preliminary tests of SiC infiltration into monolithic porous carbon and carbon-carbon preforms were conducted utilizing a pulse CVI process in which the concentration of CH_3SiCl_3 was fixed at 4.5 mo 1 percent. Employing the preferable condition, SiC matrix was deposited initially around the center of thickness and finally over the full thickness of the porous carbon preforms. In the example of the porous carbon-carbon composite preforms, SiC matrix infiltration was observed at temperatures of 1173 K, 1273 K, and 1373 K. R.E.P.

A92-45458

EVALUATION OF A DESIGN STANDPOINT OF STRUCTURAL CFRP USED IN SPACE

S. MATSUOKA, Y. NAGAO, T. KAMIYAMA (Fuji Heavy Industries, Ltd., Tokyo, Japan), T. SEGUCHI, T. SASUGA, and AKIRA UDAGAWA (Japan Atomic Energy Research Institute, Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 909-919. refs (SAE PAPER 911987) Copyright

Results of an experimental investigation tracing the effects of the thermal cycle and irradiation on mechanical properties of CFRP and adhesives are reported. The IM-6/6376 toughened epoxy composite and T800/PMR-15 heat-resistant polyimide composite, as well as nine typical types of epoxy adhesives were selected as candidate structural materials for future space applications. These materials were subjected to up to 10 MGy irradiation and/or 3000 thermal cycle (-100 to 100 C), which simulates the space environment. Specimens were mechanically tested over the above temperature ranges. The IM-6/6376 composite was not affected by irradiation and/or the thermal cycle, and it exhibited essentially good overall durability performance in the space environment. T-800/PMR-15 was not affected by irradiation, and showed good durability against radiation. The adhesives were greatly affected by irradiation and/or the thermal cycle, and showed sensitivity to the space environment. C.A.B.

A92-47104

INTERLAMINAR REINFORCEMENT OF LAMINATED COMPOSITES BY ADDITION OF ORIENTED WHISKERS IN THE MATRIX

S. YAMASHITA, H. HATTA, T. TAKEI, and T. SUGANO (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Sagami, Japan) Journal of Composite Materials (ISSN 0021-9983), vol. 26, no. 9, 1992, p. 1254-1268. Research sponsored by New Energy and Industrial Technology Development Organization. refs Copyright

To reinforce the interlaminar of laminated composites, a novel method was proposed earlier by the authors. In this method, whiskers were added in the matrix resin to reinforce the interlaminar, and the orientation of the whiskers were magnetically controlled to improve the reinforcement efficiency. In this paper, mode I (cleavage) interlaminar fracture toughness was shown to be remarkably improved as a result of the addition of oriented whiskers to the direction of the plate thickness. Whereas, mode II (inplane shear) interlaminar fracture toughness and interlaminar shear

strength were not raised. Parameters of interlaminar reinforcement such as volume fraction of whiskers and whisker dimension were also discussed for exploring the optimum condition. Author

A92-47202

EFFECT OF H₂O IN SPECIMEN AND LOADING RATE ON THE INTERFACIAL SHEAR SLIDING STRESS IN SIC/LAS COMPOSITE

KOICHI HONDA and YUTAKA KAGAWA (Tokyo, University, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 4, April 1992, p. 481-486. In Japanese. refs
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Effects of H₂O in the specimen and loading rate on the interfacial shear sliding stress in an SiC fiber-reinforced LAS matrix composite have been examined using a microindentation technique. The results show that the interfacial shear sliding resistance depends strongly on the H₂O contained in the composite. When the sample is completely dried, the measured shear sliding stress is constant within the measured loading rates. However, when the composite contains H₂O, the interfacial shear sliding stress decreases at a loading rate below 1.5 mN/s and increases at a loading rate above 1.5 mN/s in comparison with the interfacial shear sliding stress of the fully-dried composites. In the dried samples, scattering of the shear sliding stress reduces in the experiment using an argon atmosphere instead of air. Author

A92-47299

PERFORATION IMPACT BEHAVIOR OF CFRP LAMINATES

YUKIO KAWATSU and KENICHI NOGUCHI (Toray Industries, Inc., Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 721-727. In Japanese. refs
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The perforation impact behavior of CFRP laminates was studied by comparing it with that of glass fiber-reinforced plastics, aramid fiber-reinforced plastics, and 7075-T6 aluminum alloy. The effects of specimen thickness, tensile strength of unidirectional laminates, matrix tensile strain, and degree of surface treatment of carbon fibers on the perforation impact behavior were examined. The results showed that the impact resistance, the value of the maximum load, or the total absorbed energy of CFRP was proportional to the strength of unidirectional laminates and was independent of the tensile strain of the matrix and the fracture toughness of unidirectional laminates. Due to lower interfacial bonding, the impact resistance of CFRP increased when the degree of surface treatment decreased. C.D.

A92-47300

RESIDUAL STRESS CONTROL OF AL/CFRP HYBRID COMPOSITE MATERIAL

OSAMU HAGA, HIDEO KOYAMA, KATUMI KAWADA, and KAZUHIRO OGAWA (Chiba University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 728-733. In Japanese. refs
Copyright

Two methods used to control the residual thermal stress in a hybrid material made of thin aluminum alloy and unidirectional CFRP layers after curing are described. One involves curing the composite under tensile force applied to the CFRP layers only, while the other involved applying a stress which produces small plastic strain in the aluminum layers to the laminate after molding. The second method offers more precise control of the residual stresses than the first. Experimental tests showed that the tensile yield stress of controlled composite plates increased more than that of uncontrolled plates, but the compressive yield stress decreased. The ultimate strain and the interlaminar shear strength decreased due to the operational residual stress control. Acoustic emission inspection showed that much interfacial failure was produced between aluminum alloy and CFRP layer during the operation of the second method. This was a factor in the decrease in interlaminar shear strength. C.D.

A92-47301

IMPROVEMENT OF FATIGUE PROPERTY OF AL/CFRP HYBRID COMPOSITE MATERIAL BY RESIDUAL STRESS CONTROL

OSAMU HAGA, HIDEO KOYAMA, KATUMI KAWADA, and KAZUHIRO OGAWA (Chiba University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 734-739. In Japanese. refs
Copyright

The relation between stress controls and fatigue characteristics of Al/CFRP are investigated. The effect of residual stress controls was conspicuously revealed, especially on the fatigue characteristics. The crack propagation rate was reduced with the decrease of residual stress in the aluminum layers. Under a certain magnitude of mean stress and stress amplitude, it was found that crack propagation in a test piece where residual stress in the aluminum layers was converted from tension to compression was completely stopped. This material is overwhelmingly superior to monolithic aluminum alloy plates in fatigue resistance. From this fact, it was shown that CFRP in the hybrid materials has a function to prevent crack propagation in the aluminum layers. Author

A92-47302

FATIGUE STRENGTH OF PLAIN AND NOTCHED SPECIMENS OF SHORT CARBON-FIBER REINFORCED POLY-ETHER-ETHER-KETONE (IN COMPARISON WITH POLY-ETHER-ETHER-KETONE)

HIRONOBU NISHITANI, HIROSHI NOGUCHI, YUN-HAE KIM (Kyushu University, Fukuoka, Japan), and TERUTAKA YAMAGUCHI (Chugoku Electric Co., Hiroshima, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 740-745. In Japanese. refs
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A92-48252

PREPARATION OF THREE-Dimensionally ISOTROPIC SiC-ALUMINUM COMPOSITES AND THEIR MECHANICAL PROPERTIES

YUJI YAMAMOTO, HAJIME IZAWA (Osaka Cement Co., Ltd., Advanced Materials Research Laboratory, Kaizuka, Japan), SHOJIRO OCHIAI, and KOZO OSAMURA (Kyoto University, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 5, May 1992, p. 293-298. In Japanese. refs
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SiC-aluminum composites were prepared by a liquid phase hot-pressing technique on the basis of a porous silicon carbide body which forms a 3D network structure. Each of silicon carbide and aluminum composites forms a 3D network structure intermingling with each other. O.G.

A92-50933

NON-LINEAR COMPRESSION STRESS-STRAIN CURVE OF PITCH-BASED HIGH MODULUS CARBON FIBRE COMPOSITES AND STRUCTURAL RESPONSES

N. TSUJI and K. KUBOMURA (Nippon Steel Corp., Kawasaki, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 14, July 15, 1992, p. 3782-3788. refs
Copyright

The longitudinal compression behavior of unidirectional composites is studied to understand the role of the fiber compressive property in deformation and failure by systematically varying the tensile modulus of reinforcing high modulus carbon fiber. As the composites deform, their softness increases with increasing compressive strain, and the loading path is traced back when the load is removed. The intensity of softening is correlated to the fiber's tensile modulus and possible softening mechanisms are discussed in conjunction with fiber and matrix properties. Further, it is investigated how the nonlinear stress-strain relation affects the stress and strain distributions and deformation when plates fabricated from these fibers are tested by the three-point bending test. Author

24 COMPOSITE MATERIALS

A92-51206

FRACTURE TOUGHNESS, STRENGTH AND VICKERS HARDNESS OF YTTRIA-CERIA-DOPED TETRAGONAL ZIRCONIA/ALUMINA COMPOSITES FABRICATED BY HOT ISOSTATIC PRESSING

M. HIRANO and H. INADA (Noritake Co., Ltd., Research and Development Dept., Nagoya, Japan) *Journal of Materials Science* (ISSN 0022-2461), vol. 27, no. 13, July 1, 1992, p. 3511-3518. refs

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Mechanical properties of (Y, Ce)-tetragonal zirconia polycrystals (TZP)/alumina composites fabricated from fine powders by HIP were investigated, and the results were compared with those of 3Y-TZP/Al₂O₃ composites. It was found that the fracture toughness, strength, and Vickers hardness of (Y, Ce)-TZP/Al₂O₃ composites depended strongly on the HIP temperature; composites HIPed at 1600 C showed degradation in strength and fracture toughness, whereas composites HIPed at 1400 C exhibited bending strength between 1700 and 1800 MPa and fracture toughness values between 6 and 7 MPa sq rt m. Increasing the amount of Al₂O₃ resulted in increased fracture strength and hardness and the suppression of zirconia grain growth. I.S.

A92-51210

FABRICATION OF CARBON FIBRE-REINFORCED ALUMINIUM COMPOSITES WITH HYBRIDIZATION OF A SMALL AMOUNT OF PARTICULATES OR WHISKERS OF SILICON CARBIDE BY PRESSURE CASTING

H. M. CHENG, A. KITAHARA, S. AKIYAMA (Government Industrial Research Institute, Tosu, Japan), K. KOBAYASHI (Nagasaki University, Japan), and B. L. ZHOU (Chinese Academy of Sciences, Institute of Metal Research, Shenyang, People's Republic of China) *Journal of Materials Science* (ISSN 0022-2461), vol. 27, no. 13, July 1, 1992, p. 3617-3623. refs

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A92-51393

MONTE-CARLO SIMULATION OF THE TENSILE STRENGTH IN A UNIDIRECTIONAL FIBER REINFORCED METAL MATRIX COMPOSITE INCLUDING THE EFFECT OF DYNAMIC BEHAVIOR CAUSED BY FIBER BREAKS

KOICHI GODA (Hiroshima University, Higashihiroshima, Japan), KOICHI KITAHARA (Hitachi Metals Co., Ltd., Kyushu Works, Fukuoka, Japan), and HIDEHARU FUKUNAGA (Hiroshima University, Higashihiroshima, Japan) *Japan Society of Materials Science, Journal* (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 906-912. In Japanese. refs

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A92-51512

NEW THERMOPLASTIC POLYIMIDE COMPOSITE FOR SUPERSONIC AIRCRAFT STRUCTURES

T. NAGUMO, H. NAKAMURA (Fuji Heavy Industries, Ltd., Aerospace Engineering Div., Utsunomiya, Japan), T. NAKAKURA, and H. SAKAI (Mitsui Toatsu Chemicals, Inc., Yokohama, Japan) IN: *International SAMPE Technical Conference, 23rd, Kiamesha Lake, NY, Oct. 21-24, 1991, Proceedings*. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 153-161. Research sponsored by Society of Japanese Aerospace Companies.

Copyright

A novel thermoplastic polyimide composite system has been developed which furnishes excellent hot-wet compression and fracture toughness properties relative to conventional thermosets; in conjunction with innovative fabrication techniques that capitalize on the thermoplastic behavior of the matrix resin, fabrication costs may be significantly reduced. These techniques encompass press-forming, filament-winding, and fusion bonding. Attention is given to the applicability of this structural system to next-generation supersonic aircraft primary airframe structures. O.C.

A92-51836

METALLURGICAL REACTIONS AND THEIR RELATIONSHIPS TO ENHANCED MECHANICAL STRENGTH IN ZR-BEARING YBCO COMPOSITE SUPERCONDUCTORS

TETSUO OKA, YOSHITAKA ITOH, YOUSUKE YANAGI (AISIN Material Research and Development Co., Ltd., Kariya, Japan), HIDEHIKO TANAKA, SHIN-ICHI TAKASHIMA, and UICHIRO MIZUTANI (Nagoya University, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1760-1764. refs

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The metallurgical occurring during partial melting of the Zr-bearing YBCO composite superconductors have been investigated in detail by analyzing the DTA, XRD spectra and SEM micrographs of samples subjected to various heat treatments. It is shown that Zr reacts preferentially with Ba to form BaZrO₃. As a result, the 123-phase is partially disintegrated and yields CuO and the 211-phase as by-products. The CuO phase in contact with the 123-phase lowers the melting point of the 123-phase to 970 C. The Zr-bearing YBCO sample annealed above 970 C melts partially and contributes to the reduction of voids. In addition, fine BaZrO₃ particles precipitated along the grain boundaries form complicated three-dimensional networks. This skeletonlike structure prevents the sample from collapsing during partial melting and reinforces the mechanical strength of composites. Author

A92-52690

OXIDATION STABILIZATION IN THE FABRICATION OF PITCH-MATRIX CARBON-CARBON COMPOSITES

S. TAKANO (Kawasaki Steel Corp., High Technology Research Laboratories, Chiba, Japan), P. TLOMAK (Dayton, University; USAF, Astronautics Laboratory, Edwards AFB, CA), and C. P. JU (National Cheng Kung University, Tainan, Taiwan) *Journal of Materials Science Letters* (ISSN 0261-8028), vol. 11, no. 15, Aug. 1, 1992, p. 1053-1057. Research supported by Southern Illinois University. refs

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An oxidation-stabilization treatment prior to carbonization has been established to be effective in precluding the 'bloating' of mesophase pitch during carbonization, in conjunction with an enhancement of carbon yield. It is also possible that this technique may obviate high pressure presses and autoclaves, resulting in a significant cost reduction for C/C composites fabrication. An investigation is presently conducted of the oxidation stabilization of 2D pitch-matrix C/C composites. O.C.

A92-52694

MONTE-CARLO SIMULATION ON NOTCHED STRENGTH OF UNIDIRECTIONAL BORON-ALUMINIUM COMPOSITES

SHOJIRO OCHIAI and KOZO OSAMURA (Kyoto University, Japan) *Journal of Materials Science* (ISSN 0022-2461), vol. 27, no. 15, Aug. 1, 1992, p. 4061-4069. refs

(Contract MOESC-01550549)

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The fracture behavior of center-notched unidirectional boron-aluminum composites is presently simulated via Monte Carlo methodology, under the assumption of quasi-self-similar notch extension. Notched strength is found to decrease with increasing notch size for a fixed width of specimen and with increasing specimen width for a fixed relative notch size. The various semiempirical failure criteria proposed in the literature could approximately describe the notched strength obtained by the present simulation under limited conditions, despite the difference in basic concept between those models and the method here employed. It is demonstrated that the characteristic lengths in several of the extant models have a strong positive correlation with damage zone size. O.C.

A92-53515

DEVELOPMENT OF HIGH PERFORMANCE CARBON-CARBON COMPOSITES FOR SPACE APPLICATIONS

TADASHI MATSUSHITA, HIDEHIKO MITSUMA, TOMOYUKI KOBAYASHI (NASDA, Tsukuba, Japan), SHOJI MAEKAWA,

KENICHI KOSUGI (Kawasaki Heavy Industries, Ltd., Aerospace Group, Kakamigahara, Japan), NOBUO TSUCHIYA, and TSUNEO KINJO (Kawasaki Steel Corp., High-Technology Research Laboratories, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 477-482. refs

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Carbon-Carbon (C/C) is a lightweight refractory composite and a prime candidate material for hot sections of space vehicles which are exposed to severe aerodynamic heating during reentry. A resin char process was chosen for making C/C and 2D carbon cloth and phenol resin were selected for the preforming materials to get high strength and to enable relatively complex shape forming. To prevent oxidation at high temperature, multilayer coating method has been established whose main coating is Chemical Vapor Deposited (CVD) SiC. Methods for design allowable testings were evaluated and preliminary data acquisition tests are conducted. Some trial products such as an integral skin-stringer panel and other shaped components were fabricated to develop forming process and to demonstrate the feasibility of the material system.

Author

A92-53516

FABRICATION TEST AND EVALUATION OF GRAPHITE/PMR-15 POLYIMIDE FOR HOPE PRIMARY STRUCTURE

HIROBUMI TAMURA, HIDEHIKO MITSUMA, TOMOYUKI KOBAYASHI, and MOTOHIRO ATSUMI (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 483-488. refs

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This paper reports the current status of research and development of graphite/polyimide composite for the primary structure of the H-II Orbiting Plane (HOPE). The HOPE structure with graphite/polyimide will be required to employ the Thermal Protection System (TPS) on its outer surface and a thermal blanket on the inner surface which shields onboard equipment from heat soak. HOPE will be launched by the H-II rocket. After operation on orbit, HOPE will reenter the earth's atmosphere, maneuver, and land horizontally; the HOPE structure should endure this mission environment. Mechanical properties of graphite/polyimide under the expected flight environment of HOPE and the results of fabrication tests are described.

Author

A92-53517

DAMPING MATERIALS FOR SPACECRAFT STRUCTURES

JUN FUJIMOTO, RYOSUKE UGO, KAZUhide TODOME (NEC Corp., Kawasaki, Japan), and TORU TOMOSHIGE (Mitsui Petrochemical Industries, Ltd., Sodegaura, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 489-499. refs

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Low-outgas, noninflammable damping materials with high damping capability for spacecraft have been developed using a simple three-element model. The design of damping materials for satellites, crew bays in space shuttles and space stations, and sounding rockets is addressed. The mechanical dynamic properties and application to spacecraft structures of CFRP/damping material laminates are considered.

C.D.

A92-53520

DEVELOPMENT OF A SMALL DEFORMATION BODY FOR THE COLLIMATOR OF HARD X-RAY TELESCOPE OF SOLAR-A

TATSURU NOGUCHI (Japan Aircraft Manufacturing Co., Ltd., Yokohama), JUNJIRO ONODA (Institute of Space and Astronautical Science, Sagami, Japan), KAZUO MAKISHIMA, KENROU KOSUGI (Tokyo, University, Japan), SABRO OHASHI, AKIRA OBATA, YOSHIKI KAKITSUBO, and MASAOKI MATOBA (Japan Aircraft Manufacturing Co., Ltd., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th,

Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 513-518. refs

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Solar-A, a satellite intended to observe the mechanism of solar flares in the 22nd solar maximum period and launched in the summer of 1991, includes a hard X-ray telescope (HXT) made of CFRP. Here, some new methods to investigate deformations due to temperature and moisture absorption in the HXT are described.

C.D.

A92-54222

SURFACE CHARACTERIZATION OF CARBON FIBRES AND INTERFACIAL PROPERTIES OF CARBON FIBRE COMPOSITES

F. NAKAO, Y. TAKENAKA, and H. ASAI (Mitsubishi Rayon Co., Ltd., Otake, Japan) Composites (ISSN 0010-4361), vol. 23, no. 5, Sept. 1992, p. 365-372. refs

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The surface characteristics of carbon fibers treated by electrochemical oxidation have been determined, and the effect of these properties on the interfacial adhesive strength (interlaminar shear strength (ILSS) and transverse flexural strength) of epoxy-matrix composites investigated. The surface properties of the carbon fibers were dependent on the nature of the electrolyte used during the electrochemical oxidative treatment. Use of a basic electrolyte resulted in an improvement of composite ILSS and transverse flexural strength due to an increase in the number of surface functional groups. On the other hand, using an acid electrolyte resulted in the ILSS increasing with the number of surface functional groups, while the transverse flexural strength decreased for composites in which the carbon fibers had a high surface oxygen content. It is concluded that the weak boundary layer derived from fissures on the surface of carbon fibers treated in an acid electrolyte decreased the transverse flexural strength.

Author

A92-54448

PITTING CORROSION BEHAVIOR OF SiC/AL ALLOY MATRIX COMPOSITES

KAZUHIKO NODA, HITOSHI ONO, TOORU TSURU, HIROYASU TEZUKA, and AKIHIKO KAMIO (Tokyo Institute of Technology, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 6, June 1992, p. 641-647. In Japanese. refs

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The corrosion behavior of SiC/Al Metal Matrix Composite (MMC) was investigated by polarization measurement and SEM observation. The behavior of SiC/Al MMC was the same as ordinary Al alloys as matrix materials. The anodic polarization curve of SiC/Al MMC in sodium borate-boric acid buffer solution (pH 8.39) containing sodium chloride was very similar to those of ordinary Al alloys. The pitting potential of SiC/Al MMC in each sodium chloride solution was almost the same as that of the ordinary alloys. This fact indicated that the existence of the SiC did not affect breakdown of the passive film. According to the observation at the SiC/Al interface of model composites which contain macroscopic boundaries, small pits occurred at random over the whole surface after anodic polarization. Occasionally a small number of pits appeared at SiC/Al interface, suggesting the preferential sites for pit growth.

Author

A92-54500

REINFORCEMENT OF SiC WHISKER-AL₂O₃ PARTICLE/6061 ALUMINUM ALLOY COMPOSITE MATERIALS

GAOHUI WU, NORIO KONO, TSUNEO TAKAHASHI, and HISAFUJI WATANABE (Chiba Institute of Technology, Narashino, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 7, July 1992, p. 377-382. In Japanese. refs

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A mixing law for expressing the strength of composite materials reinforced by SiC whiskers and Al₂O₃ particles was investigated based on the results of tensile tests. The average length of SiC whiskers after extrusion decreases exponentially with the increase in volume fraction of whisker. A regressive expression of the

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relationship between average length and volume fraction of whiskers is proposed. It is also found that a maximum value in the tensile strength of these materials appears and varies as the strength and the volume fraction of whiskers and the strength of matrix. Therefore, an optimum combination of strength of whisker and matrix and an optimum content ratio of whiskers and particles exist. Author

A92-54543

SHEAR STRENGTH OF C/C COMPOSITES AND THEIR FIBER SURFACE-TREATMENT

YASUHIRO TANABE and EIICHI YASUDA (Tokyo Institute of Technology, Yokohama, Japan) Research Laboratory of Engineering Materials, Report (ISSN 0385-3799), no. 17, 1992, p. 137-144. Research supported by MOESC. refs

Carbon fiber reinforced carbon matrix composites (C/Cs) were prepared with surface-treated and nonsurface-treated carbon fibers and the effect of carbon fiber surface-treatment on shear strength of the C/Cs was investigated. The matrices were derived from furan resin. Shear strength of carbonized C/C with surface-treated carbon fibers (treated C/C) was much higher than that with nonsurface-treated carbon fibers (nontreated C/C). The difference between these two values was larger after higher temperature heat-treatment, i.e., graphitization. This was caused from that the graphite crystallites of the matrix in the treated C/C became larger after graphitization, as comparing with those in nontreated C/C. The shear strength of the C/C whose matrix structure was fine by addition of ultrafine graphite particles, did not increase after graphitization, because the crystallites in the matrix did not develop well. Author

A92-54554

THE FRACTURE BEHAVIOUR OF VECTRAN/EPOXY QUASI-ISOTROPIC LAMINATES

ZEN-ICHIRO MAEKAWA, HIROYUKI HAMADA, TOMOHIRO KITAGAWA, and TOSHIHIKO OKUMURA (Kyoto Institute of Technology, Japan) Advanced Composites Letters (ISSN 0963-6935), vol. 1, no. 3, 1992, p. 95-97. refs Copyright

Tensile behavior of quasi-isotropic liquid crystalline fiber reinforced composites were discussed. The fracture modes were observed by microscope and scanning electron microscope. As the result, initial fracture did not originate in 90 deg lamina, but in 45 deg lamina. Author

A92-55411

TENSILE DUCTILITY OF SUPERPLASTIC AL₂O₃-Y₂O₃-Si₃N₄/SiC COMPOSITES

TANGUY ROUXEL, FUMIHIRO WAKAI (Government Industrial Research Institute, Nagoya, Japan), and KANSEI IZAKI (Mitsubishi Gas Chemical Co., Tsukuba, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, no. 9, Sept. 1992, p. 2363-2372. refs Copyright

Results are presented from measurements of tensile ductility, from 1550 to 1650 C in N₂ atmosphere, of Si₃N₄/SiC composites containing from 28 to 33 wt pct SiC, and Al₂O₃ and Y₂O₃ as sintering additives, with various Al₂O₃/Y₂O₃ ratios and different processing conditions. Results indicate that high Al₂O₃/Y₂O₃ ratios generally led to increased ductility up to the compositions with 2 and 6 wt pct Al₂O₃ and Y₂O₃, respectively, at which 114 percent elongation was recorded. At higher Al₂O₃ contents, fracture occurred at less than 15 percent elongation. In contrast to materials containing 20 wt pct SiC (Wakai et al., 1990), there was no grain development in composites with 30 wt pct SiC during deformation at high temperature. I.S.

A92-55888

HIGH TEMPERATURE DEFORMATION OF SiC WHISKER/AZ91 MAGNESIUM ALLOY AND SiC WHISKER/2324 ALUMINUM ALLOY COMPOSITES

JUN S. KIM, JUNICHI KANEKO, and MAKOTO SUGAMATA (Nihon University, Narashino, Japan) Japan Institute of Metals, Journal

(ISSN 0021-4876), vol. 56, no. 7, July 1992, p. 819-827. In Japanese. refs

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The deformation behavior of both cast and extruded SiC(W)/AZ91 and SiC(W)/2324 composites was investigated at elevated temperatures under tensile loading. At temperatures below 573 K, the tensile strength of the extruded composites is higher than that of the matrix alloys. Above 573 K, however, the tensile strength of the extruded composites is lower than that of the matrix alloys. The tensile strength of cast SiC(W)/AZ91, however, is higher than that of the matrix alloy at all test temperatures. The lower tensile strength, higher elongation, and higher strain rate exponent of the extruded composites are attributed to their very fine microstructure, with preferential grain boundary sliding occurring at elevated temperatures. V.L.

A92-56097

CURRENT STATUS AND FUTURE OF RESEARCH DEVELOPMENT OF THERMOPLASTIC COMPOSITE MATERIALS IN NAL

TAKASHI ISHIKAWA, YOICHI HAYASHI, and MASAMICHI MATSUSHIMA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 440-443. In Japanese. refs

R & D activities of CF/thermoplastic (AS4:APC-2 = CF/PEEK) composites conducted in NAL are reviewed. Measurement of high interlaminar fracture toughness through the DCB tests is the first step. Very high tensile fatigue strengths are obtained next. Toughness plays a key role for preventing damage propagation. Compression tests after impact are conducted for thick plates of 48 plies and for stiffened panels. CF/Epoxy plates and panels are also tested for comparison. Improvement in processing technology of CF/PEEK leads to better results. Very high CAI strengths are obtained for CF/PEEK plates and panels due to excellent resistance to delamination. Author

A92-56099

SPACE ENVIRONMENT RESISTANCE OF CFRP FOR USE IN SPACE INFRASTRUCTURE

SHIGEKAZU HIGUCHI (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 448-452. In Japanese.

Structural materials for use in low earth orbit or geostationary orbit are discussed. Forming conditions of carbon fiber reinforced plastics (CFRP) are presented. Radiation-resistance testing of CFRP composite is discussed. Y.P.Q.

A92-56101

PRELIMINARY STUDY OF A POLYMER MATRIX COMPOSITE FOR FIREPROOF PANELS

TERUKUNI FUKUOKA, TATURU NOGUCHI (NIPPI, Japan), and AKIKAZU YAHATA (Japan Aircraft Development Corp., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 458-461. In Japanese. refs

A polymer matrix composite material for fireproof panels is presented. The fire resistance test is described, and its results are analyzed. The composite material properties under high temperatures are evaluated. Y.P.Q.

A92-56102

MECHANICAL PROPERTIES OF LAMINATE ALUMINUM MATRIX COMPOSITES

HIROSHI NAKATANI, TOSHIYUKI AOKI, MAMORU IMUTA, and HIROTOSHI NAKAYAMA (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 462-465. In Japanese.

To use metal matrix composites (MMCs) in aircraft structures, design techniques and low cost fabrication processes of laminate

MMCs must be developed. Here, the mechanical properties and the low-pressure process of laminate aluminum matrix composite production are described. C.D.

A92-56269

EFFECT OF SEVERAL FACTORS EVALUATION OF DAMAGE FOR METAL MATRIX COMPOSITES BY SCANNING ACOUSTIC MICROSCOPE

YOSHIIHISA TANAKA, CHITOSHI MASUDA (National Research Institute for Metals, Tokyo, Japan), CHIAKI MIYASAKA, and FUMIO UCHINO (Olympus Optical Co., Ltd., Hachioji, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 4, no. 466, July 1992, p. 1061-1067. In Japanese. refs Copyright

MMCs and aluminum alloys were examined by a scanning acoustic microscope using leaky Rayleigh waves to discuss the analysis of deformation behavior around reinforcing fibers of MMC. The plastic zone size observed was nearly equivalent to the one calculated under the plane stress condition for the A6N01 aluminum alloy, and the difference in Rayleigh wave velocity was about 2 percent between the plastic zone near a fatigue crack tip and the elastic zone. The deformation part at the tip of notch occurred preferentially in the SiC whisker-poor zone for the SiCw/A7075 composite. It is suggested that fatigue cracks initiate and propagate at the whisker-poor zone for this composite. Microstructures such as segregation of elements or precipitates can be analyzed by using the velocity of leaky Rayleigh waves. It is suggested that the microstructure and plastic zone may be separately identified in MMCs. Author

A92-57036

HIGH TEMPERATURE STRENGTH AND WHISKER/MATRIX INTERFACE OF BETA SILICON NITRIDE WHISKER REINFORCED 6061 ALUMINUM ALLOY

KATSUAKI SUGANUMA, GENN SASAKI, TERUAKI FUJITA (National Defense Academy, Kanagawa, Japan), and MITSUHIRO TOKUSE (Japan Ultra-High Temperature Materials Research Center, Yamaguchi, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 7, July 1992, p. 659-668. refs Copyright

The high-temperature strength and interface microstructure between the whiskers and matrix of the 6061 aluminum alloy matrix composite reinforced with 13 vol pct beta-phase silicon nitride are examined with TEM. As compared with the 6061 alloy, the strength of the composite increased by about 20 percent and the elongation reached about 4 percent at room temperature. The strength beyond 300 C was excellent. The whisker has the 001 line axis as the growing axis and a hexagonal cross section surrounded by six 110 planes. The whisker has a few nm-thick amorphous layers on the surface. The layer binds whiskers tightly in the preform. No trace of a severe reaction after casting was observed, but a few nm-thick crystalline layers were found on the 100-plane face of the whisker, which was determined to be aluminum nitride. P.D.

N92-17816# Japan Atomic Energy Research Inst., Tokyo. EFFECT OF THERMAL ANNEALING ON PROPERTY CHANGES OF NEUTRON-IRRADIATED NON-GRAPHITIZED CARBON MATERIALS AND NUCLEAR GRAPHITE

HIDETO MATSUO (Japan Atomic Energy Research Inst., Tokai.) Jun. 1991 20 p (DE92-704180; JAERI-M-91-090) Avail: CASI HC A03/MF A01

Changes in dimension of non-graphitized carbon materials and nuclear graphite, and the bulk density, electrical resistivity, Young's modulus and thermal expansivity of nuclear graphite were studied after neutron irradiation at 1128 to 1483 K and the successive thermal annealing up to 2573 K. Carbon materials showed larger and anisotropic dimensional shrinkage than that of nuclear graphite after the irradiation. The irradiation induced dimensional shrinkage of carbon materials decreased during annealing at temperatures from 1773 to 2023 K, followed by a slight increase at higher temperatures. On the other hand, the irradiated nuclear graphite hardly showed the changes in length, density and thermal expansivity under the thermal annealing, but the electrical resistivity

and Young's modulus showed a gradual decrease with annealing temperature. It has been clarified that there exists a significant difference in the effect of thermal annealing on irradiation induced dimensional shrinkage between graphitized nuclear graphite and non-graphitized carbon materials. DOE

N92-17869# National Aerospace Lab., Tokyo (Japan). Airframe Div.

EXPERIMENTAL INVESTIGATION OF INTERLAMINAR FRACTURE TOUGHNESS OF CARBON FIBER/THERMOPLASTIC AND CARBON FIBER/THERMOSETTING COMPOSITES BY DCB SPECIMENS

MASAMICHI MATSUSHIMA (Tokyo Inst. of Tech. (Japan).), TAKASHI ISHIKAWA (Tokyo Inst. of Tech. (Japan).), YUICHI HAYASHI (Tokyo Inst. of Tech. (Japan).), and SHIGEO KOBAYASHI (Tokyo Metropolitan Univ., Japan) 21 Jan. 1991 25 p In JAPANESE; ENGLISH summary Original contains color illustrations (ISSN 0389-4010)

(NAL-TR-1096) Avail: CASI HC A03/MF A01

Experiments were performed to measure the interlaminar fracture toughness (G sub IC) of carbon fiber (CF)/epoxy and CF/PEEK composite materials using double cantilever beam (DCB) specimens. Literature survey for extracting key points in experiments was done as the first process. Results for unidirectional CF/epoxy were obtained with a simple 'piano-hinge' type of fixture. No effect of thickness and width of specimens upon G sub IC is found if a crack length is sufficiently long. Following this, DCB tests were conducted on CF/PEEK using a specially developed loading fixture capable of withstanding high peel loads. The measured G sub IC of CF/PEEK shows 20 times higher than of unidirectional CF/epoxy. The second tests after fusion bonding exhibited similar results. A comparison of the G sub IC for the original surface, the fusion bonded surface with PEEK film and adhesion surface with epoxy adhesives demonstrated that the fusion bonding is ideal for assembling thermoplastic composite structures of complicated shape. Additionally, finite element analysis was performed to show the reliability of the present experimental method. Author

N92-20561# Japan Atomic Energy Research Inst., Tokyo. IRRADIATION EFFECTS ON RESISTANCE TO THERMAL IMPACT FOR COMPOSITES USED IN SPACE, 2

AKIRA UDAGAWA (Japan Atomic Energy Research Inst., Tokyo.), TSUNEO SASUGA (Japan Atomic Energy Research Inst., Tokyo.), TADAO SEGUCHI (Japan Atomic Energy Research Inst., Tokyo.), KENJI NAKAO (Japan Atomic Energy Research Inst., Tokyo.), TOSHIO SAKAKIBARA (Japan Atomic Energy Research Inst., Tokyo.), NORIAKI SUGAHARA (Japan Atomic Energy Research Inst., Tokyo.), TAKAYUKI KAMIYAMA (Japan Atomic Energy Research Inst., Tokyo.), YOSUKE NAGAO (Japan Atomic Energy Research Inst., Tokyo.), and KATSUMI KAMEI (Fuji Heavy Industries Ltd., Utsunomiya, Japan) Jun. 1991 52 p In JAPANESE; ENGLISH summary (DE92-731701; JAERI-M-91-099) Avail: CASI HC A04/MF A01

Mechanical properties of carbon-fiber-reinforced plastics (CFRP) and adhesives which are of practical importance for structural materials in space systems, were studied after being exposed to individual radiation, thermal shock, and a combination of both of them. The IM-6/6376 composite, which includes the modified TGDDM(DDS) matrix and high strength intermediate modulus carbon fiber (IM-6), showed sufficient adoptability for space material. The mechanical properties for fiber directions of 0 and 90 deg did not change after irradiation of up to 10 MGy and/or after thermal shock of up to 3000 cycles (-100 to approximately 100 C). Preliminary experiments were carried out using an interlaminar adhesive panel with modified epoxy resin-adhesive films. The resistance of adhesives to thermal shock was dependent on the commercial products, so that it was difficult to classify the curing condition of adhesives. It was also found that the thickness of adhesives in the panel specimens should be increased and the adhesion strength was greatly affected by thermal expansion of the adherends. The CFRP with polyimide

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resins such as PMR-15 and the newly developed CFRP with new-TPI possessed the same initial mechanical properties and no microcracks appeared after their exposure to radiation and thermal shocks. It was revealed that these materials showed high resistance to radiation and thermal shock which is of interest for their use in space systems. DOE

25

INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

A92-10294

VISUAL OBSERVATIONS OF THE AMORPHOUS-AMORPHOUS TRANSITION IN H₂O UNDER PRESSURE

OSAMU MISHIMA, K. TAKEMURA (National Institute for Research in Inorganic Materials, Tsukuba, Japan), and K. AOKI (National Chemical Laboratory for Industry, Tsukuba, Japan) Science (ISSN 0036-8075), vol. 254, Oct. 18, 1991, p. 406-408. refs

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The vapor-deposited low-density amorphous phase of H₂O was directly compressed at 77 kelvin with a diamond-anvil cell, and the boundary between the low-density amorphous phase and the high-density amorphous phase was observed while the sample was warmed under compression. The transition from the low-density amorphous phase to the high-density amorphous phase was distinct and reversible in an apparently narrow pressure range at about 130 to 150 kelvin, which provided experimental evidence for polymorphism in amorphous H₂O. Author

A92-11751

AN EXPERIMENTAL STUDY ON DETAILED FLAME STRUCTURE OF LIQUID FUEL SPRAYS WITH AND WITHOUT GASEOUS FUEL

KAZUYOSHI NAKABE, YUKIO MIZUTANI (Osaka University, Suita, Japan), TOMOYUKI HIRAO (Mazda Motor Corp., Hiroshima, Japan), and HIROYUKI FUJIOKA (Toyota Motor Corp., Japan) Combustion and Flame (ISSN 0010-2180), vol. 84, March 1991, p. 3-14. Research supported by MOESC. refs

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Flame structures of liquid fuel sprays with and without gaseous fuel (dual-fuel/single-fuel sprays) were observed in detail by monitoring simultaneously the light emissions in OH and CH bands, and the pedestal (Mie-scattering) and Doppler (velocity) signals of a laser Doppler velocimeter at and downstream of the flame front of sprays with and without gaseous fuels. The results of a statistical analysis of the four signals showed that the transition in the flame structure from a dual-fuel to a single-fuel spray was not radical but mild; the region of gas-phase reaction moved gradually from inside to outside of a droplet cluster. The study confirms the Fourier-like complex structure of the flames of dual-fuel/single-fuel sprays. I.S.

A92-11762

DIFFUSION-FLAME EXTINCTION OF LIQUID FUEL AT ELEVATED PRESSURES

TAKASHI NIIOKA, SUSUMU HASEGAWA, TATSURO TSUKAMOTO (Tohoku University, Sendai, Japan), and JUN'ICHI SATO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) Combustion and Flame (ISSN 0010-2180), vol. 86, July 1991, p. 171-178. Research supported by Science and Technology Agency of Japan. refs

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The objective of this study is to determine the effect of pressure on droplet size at extinction of the diffusion flame around the droplet. An analogy between the diffusion flame in a stagnation-point flow on a liquid fuel and that of a droplet is given, and an analytical equation is obtained for the relationship

between both diffusion flame extinctions. This equation makes it possible to calculate droplet diameter at extinction without any chemical parameters. In order to obtain extinction velocities, experiments are conducted for the diffusion flame in a stagnation-point flow at elevated pressures. The extinction velocity increases with pressure, but it becomes almost constant at pressures from about 0.3 to 1 MPa. From these data, it is found that the droplet diameter at extinction decreases sharply with pressure. Author

A92-11764

IGNITION AND COMBUSTION OF SMALL BORON LUMPS IN AN OXYGEN STREAM

S. YUASA and H. ISODA (Tokyo Metropolitan Institute of Technology, Hino, Japan) Combustion and Flame (ISSN 0010-2180), vol. 86, Aug. 1991, p. 216-222. Research supported by MOESC. refs

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The spontaneous ignition and combustion of small boron lumps were studied experimentally by using the stagnation region of an impinging oxygen stream. The critical ignition temperature was measured, and the ignition was observed to occur in the gas phase, but the ignition process was rather different from those of metals with high vapor pressures at low temperatures. It was also found that, during the combustion, the burning lumps were melted, and gas-phase reactions of BO and BO₂, not boron vapor, proceeded in the green-white radiating zone close to the boron surface. There existed a critical oxygen concentration below which self-sustained combustion with the gas-phase reactions could not occur. The ignition mechanism is discussed, and the role of surface reactions and condensation of B₂O₃ on the surface is clarified. Author

A92-13670

SURFACE CHARACTERIZATION OF CARBON FIBERS EXPOSED TO 5 EV ENERGETIC ATOMIC OXYGEN BEAM STUDIED BY WETTING FORCE MEASUREMENTS

MASAHITO TAGAWA, NOBUO OHMAE, MASATAKA UMENO (Osaka University, Suita, Japan), AKEMI YASUKAWA, KEIKO GOTOH, and MIEKO TAGAWA (Nara Women's University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2134-2138. Research supported by MOESC. refs

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Changes of the contact angle hysteresis and the surface free energy of carbon fibers due to the irradiation of energetic atomic oxygen were investigated using the Wilhelmy technique. The contact angle hysteresis became larger with increasing atomic oxygen fluence, and was due to the receding contact angle. Results of Auger electron spectroscopic analysis indicate that the hysteresis of the contact angle is proportional to the surface oxygen concentration and the polar component of surface free energy. O.G.

A92-14649

STABILIZATION OF SUPERIONIC ALPHA-AGI AT ROOM TEMPERATURE IN A GLASS MATRIX

MASAHITO TATSUMISAGO, YOSHIKANE SHINKUMA, and TSUTOMU MINAMI (Osaka Prefecture University, Sakai, Japan) Nature (ISSN 0028-0836), vol. 354, Nov. 21, 1991, p. 217, 218. Research supported by MOESC. refs

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Success is reported in depressing the alpha - beta transformation temperature for AgI so as to stabilize alpha-Agi itself at room temperature. A melt-quenching technique is used to prepare crystallites of alpha-Agi frozen into a silver borate glass matrix. The quenched material showed diffraction peaks characteristic of alpha-Agi and displayed ionic conductivities of about 0.1 S/cm. Further development of these glass/crystal composites may make the high ionic conductivity of alpha-Agi available for room-temperature solid-state applications. C.D.

A92-15361

A PREMIXED TURBULENT FLAME STRUCTURE MODEL HAVING REACTANT ISLANDS AND FRACTAL FLAME SURFACES - FORMULATION AND TEST OF THE MODEL

HIROYUKI KIDO, SHUWEI HUANG, and KENSHIRO NAKASHIMA (Kyushu University, Fukuoka, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 509-519. refs (Contract MOESC-02650159)

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A model for the premixed turbulent flame structure has been developed in which the flame zone of a turbulent flame is composed of two parts: a wrinkled flame front and some island flamelets behind it. Their fractions are supposed to vary continuously according to a proposed function of u' / S_{LO} , where u' is the turbulence intensity and S_{LO} is the laminar burning velocity. All flamelets were assumed to be fractal ones. The concepts of 'flame thickness' and 'transition time' for laminar flames were introduced into the model for turbulent flames. The model provides not only the structural parameters, but also the burning velocities of turbulent flames.

Author

A92-15362

DISCUSSION OF A WRINKLED LAMINAR FLAMELET MODEL IN A DIFFUSION FLAME IN GRID TURBULENCE

HIROYASU MANAKO, TOSHIHISA UEDA, and MASAHIKO MIZOMOTO (Keio University, Yokohama, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 520-526. refs

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The temperature has been measured in a field in which laminar hydrogen (6.0 m/s at the center of a burner exit) was injected into a coflowing air stream (6.0 m/s) with certain kinds of grid turbulence. It is shown that the ratio of a laminar flame length to the turbulent one is proportional to the turbulent Reynolds number in the measured extent (equal to or less than 1000), and therefore, that the integral scale of a reactant flow is an important parameter for the flames in this paper. The width of a flame displacement is estimated from the temperature profiles when the flame is assumed to be a wrinkled laminar flamelet. The width is also measured directly by a flow visualization method. Both the widths obtained by the two different methods agree well with each other. This indicates that the turbulent flame in this paper can be treated as a wrinkled laminar flamelet.

Author

A92-15363

AERODYNAMIC STRUCTURE OF A LAMINAR BOUNDARY LAYER DIFFUSION FLAME OVER A HORIZONTAL FLAT PLATE - EXPERIMENTAL ANALYSIS

TOSHIHISA UEDA, NAOKI SAITO, MASAHIKO MIZOMOTO (Keio University, Yokohama, Japan), and AKIRA OOSHIMA (Matsushita Juusetsu Kiki, Yamatokoriyama, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 527-532. Research supported by MOESC. refs

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Experimental investigations on the aerodynamic structure of a laminar boundary layer diffusion flame over a horizontal flat plate have been performed. When a fuel (methane) is injected upward, the velocity around a flame zone is locally accelerated, and the velocity gradient at the wall is increased as compared with that of an isothermal flow. On the other hand, when a fuel is injected downward, the velocity is retarded, and the velocity gradient at the wall is decreased not only in the downstream region of the leading flame edge but also in the upstream region. This shows that the gravitational force varies the local pressure distribution not only in the downstream region of the leading flame edge but also in the upstream region. It is also elucidated that the velocity gradient of the free stream velocity varies the velocity profiles in a boundary layer.

Author

A92-16551

PROPAGATION OF UNSTEADY HYDROGEN PREMIXED FLAMES NEAR FLAMMABILITY LIMITS

SEISHIRO FUKUTANI, SATORU YAMAMOTO, and HIROSHI

JINNO (Kyoto University, Japan) IN: Symposium (International) on Combustion, 23rd, Orleans, France, July 22-27, 1990, Proceedings. Pittsburgh, PA, Combustion Institute, 1991, p. 405-411. refs

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The present study investigates the structure and propagation mechanism of spherically propagating hydrogen-air premixed flames under the conditions of various fuel concentrations and initial temperatures in order to shed light on the essential factors influencing propagation of the flames near the lean flammability limits. Measurements of the burning velocity indicated that flames with adiabatic flame temperature lower than 890 K cannot extend up to 100 mm in diameter. The hydrogen flames were also simulated using a model consisting of a full set of combustion reactions of hydrogen and the governing equations for spherical expansion of gases. As a result of decreasing adiabatic flame temperature the actions belonging to the high-temperature reaction mechanism of hydrogen flames can be well activated. The low-temperature reactions are also depressed because of the insufficient amount of hydrogen atoms which usually diffuse from the high-temperature regions, and the temperature of the gas mixtures is thermally raised.

P.D.

A92-16600

EFFECTS OF TURBULENT MIXING ON SPRAY IGNITION

YUKIO MIZUTANI, KAZUYOSHI NAKABE (Osaka University, Suita, Japan), and JIN D. CHUNG (Korea Institute of Machinery and Metals, Changwon, Republic of Korea) IN: Symposium (International) on Combustion, 23rd, Orleans, France, July 22-27, 1990, Proceedings. Pittsburgh, PA, Combustion Institute, 1991, p. 1455-1460. refs

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A controlled turbulence is generated about a column of cetane droplets to examine the effects of turbulent mixing on its ignition process. Turbulence-generating rods are placed upstream of the spray column to determine whether the intensity generated by turbulent mixing determines the possibility of ignition at certain temperatures. The turbulence generated by the rods significantly lowered the ignition-limit temperature to 840 K from 1100 K. Additionally, the ignition delay is reduced as the intensity or turbulence is increased. Normal spray combustion can be subsequently maintained in the low-temperature atmosphere without the operation of the shock tube, and the light emission increases. The ignition process is concluded to be governed by the gas-phase reaction of the fuel vapor originating from micromist.

C.C.S.

A92-16603

EXPERIMENTAL INVESTIGATION OF FREE DROPLET COMBUSTION UNDER MICROGRAVITY

H. HARA and S. KUMAGAI (Noritz Corp., Research Laboratory, Hachioji, Japan) IN: Symposium (International) on Combustion, 23rd, Orleans, France, July 22-27, 1990, Proceedings. Pittsburgh, PA, Combustion Institute, 1991, p. 1605-1610. refs

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A new apparatus for free droplet combustion under microgravity was developed. The principle of the new apparatus is as follows: a fuel droplet is suspended at the overlapping ends of two opposed filaments, under a microgravity condition, the filaments are rapidly pulled away from each other at the same time and speed to release the droplet immediately after ignition. To realize the above process, a pin-jointed rhombic frame is employed, which is mounted around the combustion chamber. The feasibility and reliability of experiments with the apparatus are much higher than those of the previous one. By using the new apparatus, experiments were conducted to obtain the characteristics of droplet combustion with special reference to the middle and later periods of burning, and n-heptane and ethyl alcohol were examined as a sooting and a nonsooting fuel, respectively. The results obtained are as follows: the flame/droplet diameter ratio increases at the early period of burning for both fuels and then, at the later period, the ratio increases for n-heptane and decreases for ethyl alcohol,

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respectively. The assumption of quasi-steady burning of droplets cannot be verified. Extinction can be observed for both fuels, and burn-out, only for n-heptane. Author

A92-16611

STUDY OF TURBULENT FLAME PROPAGATION NEAR THE LIMITS OF INFLAMMABILITY AT MICROGRAVITY

T. KAWAKAMI, S. OKAJIMA, and K. IINUMA (Hosei University, Japan) IN: Symposium (International) on Combustion, 23rd, Orleans, France, July 22-27, 1990, Proceedings. Pittsburgh, PA, Combustion Institute, 1991, p. 1663-1667. refs

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Experiments have been carried out to examine the turbulent burning velocity and the effect of turbulence intensity on the burning velocity near the limits of inflammability, using the freely-falling chamber technique. Isotropic turbulence is generated by moving a pair of perforated plates covered by wire mesh in the combustion chamber, and the turbulent burning velocity is estimated by Sokolik's method, where the molecular weight and temperature of the burnt gas are evaluated from the chemical equilibrium at constant pressure under adiabatic conditions. The results show that (1) the turbulent burning velocity for a methane-air mixture increases with increasing turbulence intensity even at near the limits of inflammability, and (2) the ratio of turbulent to laminar burning velocity is much larger toward the extremely lean and rich mixtures than at the stoichiometric mixture and the increase of the ratio is more distinctive on the fuel lean side than on the fuel rich side. This fact indicates that preferential diffusion plays a very important role in turbulent flame propagation near the limits of inflammability. Author

A92-21142

VAPORIZATION OF GRAPHITE IN PLASMA ARC AND IDENTIFICATION OF C₆₀ IN THE DEPOSIT

OSAMU MATSUMOTO, HIROYUKI OONUMA, and HARUO UYAMA (Aoyama Gakuin University, Tokyo, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, Jan. 1992, p. L8, L9. refs

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Vaporization of graphite in the Ar-He plasma arc at atmospheric pressure has been carried out. Carbon soot sample was deposited on the wall of the arc chamber in a higher deposition rate. Small amounts of C₆₀ was identified in the product by means of visible-UV spectroscopy and X-ray diffraction methods. The existence of C₆₀ in the benzene soluble fraction of the deposit was made sure by means of Raman spectroscopy as well as by mass spectroscopy. Author

A92-24619

SURFACE STRUCTURES OF HIGH-QUALITY DIAMOND CRYSTALS SYNTHESIZED BY THE OXY-ACETYLENE FLAME METHOD

KEIJI HIRABAYASHI (Canon, Inc., Research Center, Atsugi, Japan), SHUJI AMANUMA, and YOICHI HIROSE (Nippon Institute of Technology, Saitama, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 3, 1992, p. 574-576. refs

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The microstructures of the 111-plane surfaces of high-quality diamond crystals deposited by the oxy-acetylene flame method have been studied using a high-resolution scanning electron microscope to clear the mechanism of the crystal growth. On the 111-plane surfaces of the high-quality diamond crystals, the 2D nucleation rate is suppressed and the 2D crystal growth rate is promoted. The suppression of the 2D nucleation rate and the promotion of the 2D crystal growth rate reduce the number of faults, dislocations, and defects and result in the formation of high-quality diamond crystals. Author

A92-25025

TWO-DIMENSIONAL DIGITAL IMAGING OF THE CH DISTRIBUTION IN A NATURAL GAS/OXYGEN FLAME AT ATMOSPHERIC PRESSURE AND DETECTION OF A-STATE EMISSION BY MEANS OF C-STATE EXCITATION

AKIRA HIRANO, MASAMICHI IPPOMASTU, and MASAHIRO TSUJISHITA (Osaka Gas Co., Ltd., Fundamental Research Laboratories, Japan) Optics Letters (ISSN 0146-9592), vol. 17, Feb. 15, 1992, p. 303, 304. refs

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With laser-induced fluorescence, images of the distribution of intermediate species in flames usually have been taken under the condition that the excitation electronic state and emission electronic state are the same. Two-dimensional CH distribution was photographed in a natural gas/oxygen flame through a 431-nm bandpass filter with A-state emission by means of C-state excitation (312 nm). This method provides a smaller signal than the A-state excitation method does but is free from the scattering of the pumping laser beam surrounding the burner nozzle and Rayleigh scattering. Furthermore, this method makes it possible to observe semiquantitative CH distribution. Author

A92-26471

LONG TIME FLUCTUATION OF LIQUID WATER - 1/f SPECTRUM OF ENERGY FLUCTUATION IN HYDROGEN BOND NETWORK REARRANGEMENT DYNAMICS

MASAKI SASAI (Institute for Molecular Science, Okazaki; Nagoya University, Japan), IWAO OHMINE (Institute for Molecular Science, Okazaki, Japan), and RAMAKRISHNA RAMASWAMY (Institute for Molecular Science, Okazaki, Japan; Jawaharlal Nehru University, New Delhi, India) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, Feb. 15, 1992, p. 3045-3053. refs

(Contract MOESC-03231103; MOESC-03740249)

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The power spectrum of the potential energy fluctuation of liquid water is examined and found to yield so-called 1/f frequency dependence (f is frequency). This is in sharp contrast to spectra of simple liquids (e.g., liquid argon), which exhibit a near white spectrum. This indicates that there exists an extended multiplicity of hydrogen bond network relaxations in liquid water. A simple model of cellular dynamics is proposed to explain this frequency dependence. On the other hand, the cluster dynamics of argon also involves energy fluctuations of a 1/f type, resulting from various relaxation processes at core and surface. Author

A92-26703

RECENT PROGRESS IN COMBUSTION SYNTHESIS OF HIGH-PERFORMANCE MATERIALS IN JAPAN

MITSUE KOIZUMI (Ryukoku University, Kyoto, Japan) and YOSHINARI MIYAMOTO (Osaka University, Ibaraki, Japan) IN: Combustion and plasma synthesis of high-temperature materials. New York, VCH Publishers, 1990, p. 54-60. refs

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Research and development (R&Ds) on the self-propagating high-temperature synthesis (SHS) method is actively expanding in Japan. The trend is toward process development for a variety of high-performance materials. This paper reports the current status of R&Ds in combustion synthesis for ceramic powders and intermetallic alloys, combustion sintering for ceramics, the centrifugal-thermit process for ceramic coating, and single-crystal growing from polycrystalline rods prepared by SHS. Author

A92-26715

FABRICATION OF A FUNCTIONALLY GRADIENT MATERIAL BY USING A SELF-PROPAGATING REACTION PROCESS

NOBUHIRO SATA, NORIO SANADA (Government Industrial Research Institute, Sendai, Japan), TOHRU HIRANO (Daikin Industries, Ltd., Sakai, Japan), and MASAYUKI NIINO (National Aerospace Laboratory, Kakuda, Japan) IN: Combustion and plasma synthesis of high-temperature materials. New York, VCH Publishers, 1990, p. 195-203. Research supported by Science and Technology Agency of Japan. refs

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The design and the production of a functionally gradient material by using a self-propagating reaction process has been investigated. Cu-TiB₂ composites were fabricated with stepwise compact interlayers of Ti, Cu, and B mixed powders. The maximum

temperature of product was calculated for the adiabatic reaction, and the reaction propagating regions were obtained experimentally for Ti-2B-TiB₂-Cu mixed powder. Author

A92-32387

BASIC STUDY ON LASER PHYSICAL VAPOUR DEPOSITION OF CERAMICS

A. MATSUNAWA, S. KATAYAMA (Osaka University, Ibaraki, Japan), H. MIYAZAWA (Nippon Institute of Technology, Saitama, Japan), S. HIRAMOTO, K. OKA, and M. OHMINE (Mitsubishi Electric Corp., Amagasaki, Japan) IN: Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 176-184. refs

Copyright

A basic study on the laser physical vapor deposition (PVD) of ceramics was conducted using a CW Nd:YAG laser. Alumina-ceramic and nickel plates were used as target and substrate materials, respectively. The experiment was carried out over a wide range of PVD conditions, i.e. substrate temperature up to 1100 K and pressures up to 6.5×10^{-4} Pa. A Knoop hardness (HK) tester and a scratch tester were used to evaluate the deposited film. Phase content, microstructure and chemical composition were examined by X-ray diffraction, scanning electron microscopy, and energy dispersive X-ray analysis. Results showed that a crystallized film with a hardness HK of 30 GPa or greater could be obtained by providing a suitable combination of PVD conditions. Author

A92-33474

THE EFFECT OF OXYGEN ON DIAMOND SYNTHESIS IN A MICROWAVE PLASMA JET

KEN TAKEUCHI and TOYONOBU YOSHIDA (Tokyo, University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, March 15, 1992, p. 2636-2639. refs

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The effect of oxygen on diamond synthesis in a microwave plasma jet is investigated using optical emission spectroscopy and quadrupole mass spectroscopy. It is found that oxygen seems to remove C₂H₂ selectively in a boundary layer by producing CO. Both the ratio of hydrocarbons to hydrogen in a source gas and that of CH(x) to C₂H₂ in a boundary layer are very important for the synthesis of diamond. Oxygen may provide an advantageous environment for diamond synthesis rather than for the removal of nondiamond carbons. C.D.

A92-37325

EXPERIMENTAL STUDY OF THE STRUCTURE OF PREMIXED TURBULENT FLAMES USING THE SCHLIEREN PHOTOGRAPHY AND A MICRO-PROBE METHOD

SHUWEI HUANG and HIROYUKI KIDO (Kyushu University, Fukuoka, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 51, no. 4, Dec. 1991, p. 243-266. refs

The structure of premixed turbulent flames in a constant-volume combustion chamber was investigated by using the schlieren photography and a micro-probe method. The schlieren photography was used to visualize the fine structure of the flames, where the laminar flame thickness, the laminar burning velocity and the oxygen concentration of the mixture, and the turbulence intensity were varied independently to show their respective effects on the flame structure. The micro-probe method, which detects a flamelet by detecting its flame potential signal, was used to investigate the deeper flame structure behind the flame front. The experimental results of this work suggest the existence of 'reactant islands' behind the flame front when the turbulence was intensified to some extent, with the critical (lowest) ratio of the turbulence intensity to the laminar burning velocity being found to be about 2 for the formation of reactant islands for ten different mixtures. Author

A92-37812

LAYERED-STRUCTURE BC₂N AS A NEGATIVE ELECTRODE MATRIX FOR RECHARGEABLE LITHIUM BATTERIES

MASAYUKI MORITA, TOMOYUKI HANADA, HIROMORI TSUTSUMI, YOSHIHARU MATSUDA (Yamaguchi University, Ube, Japan), and MASAYUKI KAWAGUCHI (Central Glass Co., Ltd., Ube Research Center, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, no. 5, May 1992, p. 1227-1230. refs

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A new compound with graphite-like structure, BC₂N, has been synthesized by a vapor-phase reaction of acetonitrile and borontrichloride. The electrochemical behavior of BC₂N was investigated in propylene carbonate (PC)-based solutions containing lithium (Li) salts. Cyclic voltammetric curves of the BC₂N electrode showed current increases during the cathodic potential scans and corresponding peaks at ca. 1.5 V in the anodic scans. The cathodic currents were accompanied by electrochemical interaction of Li from the electrolyte, and the anodic peaks resulted from the deintercalation of Li from the BC₂N electrode. The polarization behavior of Li with the BC₂N matrix depended on the solvent as well as the salt of the electrolytic solution. The coulombic efficiency for charge/discharge cycling under a constant current was 90 percent or higher in LiClO₄/PC. The results indicate that BC₂N is usable as a negative electrode matrix for rechargeable Li batteries. Author

A92-42798

STUDIES ON THE MECHANISM OF IGNITION AND FLAMEHOLDING BY PLASMA JETS

HIDEYUKI HORISAWA, ITSURO KIMURA, and MASAMI SAYAMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 285-294. In Japanese. refs

Studies on the mechanism of ignition and flame-holding by upstream-injection plasma jets were conducted for H₂ diffusion flames in high speed air streams. The plasma jets were operated with Ar gas involving active species such as O₂, N₂, and H₂, in the range of relatively low power. It was observed that for ignition and flame holding, the concentration of active species in feedstock is more important than plasma jet power. This fact suggests the effectiveness of active species produced by plasma jets, rather than that of plasma jet power. This fact suggests the effectiveness of active species produced by plasma jets, rather than that of plasma-jet thermal energy, and also the importance of radical concentration supplied to the ignition-point of a fuel jet, compared to the total quantity of radicals produced. It was also found that the effectiveness of additives is in the order, O₂ greater than or equal to N₂ greater than H₂, and the results of numerical simulation on combustion-reaction promotion by the radicals added agreed qualitatively with the experimental ones. Author

A92-42799

THE FORMATION AND DISAPPEARANCE OF FLAME ISLANDS IN REACTING MIXING LAYER

XIAO WANG and TOSHI FUJIWARA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 295-301. In Japanese. refs

The 2D reacting mixing layer is numerically simulated by the integral of unsteady incompressible Navier-Stokes equations. The chemical reaction is based on the one-step irreversible model with fast chemical kinetics, and the 'flame sheet' model is used to describe the location and shape of combustion front. The structure of flame and its evolution are demonstrated. The processes of formation, evolution and disappearance of flame islands and the effect of diffusion on these processes are studied. Author

A92-42824

ELECTRICAL PROBING OF DIAMOND GROWTH IN FILAMENT-ASSISTED CVD

Y. HIROSE, H. TAKEHANA, M. MITSUIZUMI, J. MORIGUCHI (Nippon Institute of Technology, Saitama, Japan), and Y. HORIE

25 INORGANIC AND PHYSICAL CHEMISTRY

(North Carolina State University, Raleigh) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 263-267. refs
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The finding of a distinct electrical resistance change between a substrate and a filament that signals the nucleation and growth of diamond in filament-assisted CVD is reported. This signature is only observed under the conditions of reverse bias in which the substrate is held at a negative potential to the filament. It appears that even the nature of carbon deposits and their growth rates can be diagnosed using the profile of this resistance change. The results have been confirmed for a variety of source-gas mixture ($\text{C}_2\text{H}_5\text{OH} + \text{H}_2$, $\text{CH}_4 + \text{H}_2$ and CH_3OH) and substrate materials (Mo, Si, Cu, and Fe) over a wide range of synthesis conditions.

Author

A92-42832

STUDY OF DEPOSITION MECHANISM OF DIAMOND BY JET-FEED METHOD

TETSUJI YASUDA, K. MIYAMOTO, M. IHARA, and H. KOMIYAMA (Tokyo, University, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 353-358. refs
Copyright

The mechanism of diamond deposition was studied using a jet-feed method. The jet-feed reactor has a gas inlet with a diameter of 3 mm at the center of the substrate holder. By feeding CH_4 and C_2H_2 with this method, the gas-phase composition can be controlled to be highly CH_4 rich or highly C_2H_2 rich. Since diamond deposition took place in both CH_4 rich and C_2H_2 rich ambients, it is concluded that both C1 and C2 species are the precursors of diamond deposition. Degradation of crystallinity with increasing distance from the jet aperture is also discussed in terms of larger carbon species diffusing from the free convection flow.

Author

A92-45420

A SIMPLIFIED-MODEL APPROACH TO GROUP COMBUSTION OF FUEL SPRAY

TOYOHICO SUZUKI, YOSHITAKA OCHIAI, SEIICHI TANABE (Tottori University, Japan), and YUZURU OHMORI (Toyota Motor Corp., Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 501-512. refs
(SAE PAPER 912032) Copyright

Combustion of a liquid fuel spray distributed in a uniform stream was analyzed with a distributed source mode. In this model, each fuel droplet of the spray is expressed mathematically by the moving source, of which the strength is to be determined by the relevant governing equations and boundary conditions. The main equation is an integral equation which expresses the interrelation among strengths of fuel droplets in the spray. Given the assumptions of a uniform velocity of the stream and zero-relative velocity of fuel droplets, the spatial variation of the droplet radii can be expressed by a differential equation with respect to a spatial coordinate y . Thus, the set of coupled equations can be solved numerically and iteratively. Then, the nature of the distributed spray combustion in the convective flow is seen to be governed by two nondimensional parameters, known to be group combustion numbers.

Author

A92-47113

SURFACE MODIFICATION OF METAL HYDRIDE NEGATIVE ELECTRODES AND THEIR CHARGE/DISCHARGE PERFORMANCE

CHIAKI IWAKURA, MASAO MATSUOKA, KATSUHIKO ASAI, and TATSUOKI KOHNO (Osaka Prefecture, University, Sakai, Japan) Journal of Power Sources (ISSN 0378-7753), vol. 38, no. 3, May 1992, p. 335-343. refs
Copyright

Negative electrodes consisting of a multicomponent alloy,

$\text{MmNi(3.6)Mn(0.4)Al(0.3)Co(0.7)}$, in a porous nickel substrate were modified by using different kinds of electroless plating baths or alkaline solutions containing hypophosphite as a reducing agent. Electrochemical properties of the negative electrodes such as discharged capacity, electrocatalytic activity for the hydrogen electrode reaction, and high-rate dischargeability were examined in a 6 M KOH solution. It was found that such simple surface modifications as described here improved the performance of negative electrodes.

Author

A92-48647

THE IMPEDANCE OF LITHIUM ELECTRODES IN LiPF₆-BASED ELECTROLYTES

NORIO TAKAMI, TAKAHISA OHSAKI (Toshiba Corp., Chemical Laboratory, Kawasaki, Japan), and KUNIYAKI INADA (Toshiba Battery Corp., Tokyo, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, no. 7, July 1992, p. 1849-1854. refs
Copyright

The impedance spectrum of a lithium electrode in an LiPF₆-based electrolyte exhibits one or two semicircles. The variation of the two semicircles with immersion time indicates the presence of two kinds of passivating surface films. The change in resistance (ΔR_1) associated with the first film during the first 24 h immersion time increased with increasing LiPF₆ concentration. The large value of ΔR_1 in a degraded LiPF₆ electrolyte indicated that the decomposition of PF₆⁻ would lead to the formation of a thick passivating film. ΔR_1 was well correlated with the oxidation potential of the solvent, which measures the stability of the solvent against lithium. The change in resistance of the second film over 24 h was smaller than for the first film. The most effective solvent for decreasing ΔR_1 was an ethylene carbonate (EC)/2-methyl-tetrahydrofuran (2MeTHF) mixed solvent. The lithium cycling efficiency in various solvent systems was demonstrated to increase with a decrease in ΔR_1 . The efficiency of the LiPF₆-EC/2MeTHF electrolyte varied significantly with LiPF₆ concentration.

Author

A92-49532

STUDY ON DYNAMICAL STRUCTURE IN WATER AND HEAVY WATER BY LOW-FREQUENCY RAMAN SPECTROSCOPY

K. MIZOGUCHI, A. HORI, and Y. TOMINAGA (Ochanomizu University, Tokyo, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 97, no. 3, Aug. 1, 1992, p. 1961-1968. Research supported by MOESC. refs
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Depolarized Raman spectra below 250/cm in water and heavy water were measured and analyzed from 373 K to the supercooled region. The spectral feature of the central component below 20/cm is stressed. The spectra below 250/cm in water and heavy water are interpreted as a superposition of one Debye-type relaxation mode and two damped harmonic oscillators. The damped harmonic oscillators (broadbands around 60/cm and 190/cm) are interpreted as the restricted translational modes. Analyzing the temperature dependence of the relaxation mode, the reciprocal relaxation time $\tau \exp^{-1}$ in heavy water changes linearly with $\tau \exp^{-1}$ varies as (T-240 K) in the whole temperature range. On the other hand, the temperature dependence of the reciprocal relaxation time in water above 303 K deviates from a straight line which holds below 298 K as $\tau \exp^{-1}$ varies as (T-225 K).

Author

A92-50480

SYNTHESIS OF MOS₂ THIN FILM BY CHEMICAL VAPOR DEPOSITION METHOD AND DISCHARGE CHARACTERISTICS AS A CATHODE OF THE LITHIUM SECONDARY BATTERY

NOBUYUKI IMANISHI, KIYOSHI KANAMURA, and ZEN-ICHIRO TAKEHARA (Kyoto University, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, no. 8, Aug. 1992, p. 2082-2087. refs
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The characteristics of Li diffusion in MoS₂, used as a cathode in a Li secondary battery were investigated. The cathode system was simplified by using the c-axis-oriented MoS₂ thin film prepared by chemical vapor deposition, with the edge of planar crystal

exposed directly to the electrolyte (propylene carbonate containing 1.0 M LiBF₄). When this film is discharged, Li diffuses in one direction through the van der Waals gap and the mathematical treatment of Li diffusion is simplified. The current-time transient in the course of the potentiostatic discharge was calculated assuming the finite 1D diffusion of Li, and the diffusion coefficients were estimated from the comparison of the observed curve with the calculated one using MoS₂ film. The diffusion coefficient was estimated to be 5.8×10^{-13} cm²/sec. In the potential region from 1.5 to 1.2 V vs. Li/Li(+), the simple diffusion model could not be applied due to the decrease of crystallinity of Li(x)MoS₂ occurring in this region. I.S.

A92-51454

HIGH-PRESSURE BRILLOUIN STUDIES AND ELASTIC PROPERTIES OF SINGLE-CRYSTAL H₂S GROWN IN A DIAMOND CELL

H. SHIMIZU and S. SASAKI (Gifu University, Japan) Science (ISSN 0036-8075), vol. 257, no. 5069, July 24, 1992, p. 514-516. refs

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High-pressure Brillouin spectra of crystalline hydrogen sulfide (H₂S) have been measured at up to 7 gigapascals at room temperature. The best fit of the angular dependence of Brillouin acoustic velocities between experimental values and calculations based on Every's expression for elastic waves of an arbitrary direction yielded the orientation of an H₂S cubic crystal grown in the diamond-anvil high-pressure cell. In situ determinations of sound velocities, as a function of pressure, could be made for any direction, the refractive index, the density, and the elastic constants. This method provides a means for the systematic study of elastic properties and phase transitions of condensed gases under ultrahigh pressures. Author

A92-51592

A MODEL FOR THE STRUCTURE AND BURNING VELOCITY OF PREMIXED TURBULENT FLAMES

SHUWEI HUANG and HIROYUKI KIDO (Kyushu University, Fukuoka, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 52, no. 1, March 1992, p. 95-116. refs

A model for predicting the structure and the burning velocity of premixed turbulent flames is developed, in which the flamelets in the flame zone of a turbulent flame consist of two parts, a wrinkled flame front and islandlike flamelets behind it. The fractions of the two components vary continuously according to a proposed function $u\text{-prime}/S(L_0)$, where $u\text{-prime}$ is the turbulence intensity and $S(L_0)$ is the laminar burning velocity. The model-predicted structure parameters of a flame and the turbulent burning velocities are presented in the form of contours referred to as flame-structure diagrams and turbulent-burning-velocity diagrams, respectively. The diagrams show the general correlation between the flame structure and the turbulent burning velocity. I.S.

A92-52213

ELECTRODEPOSITION OF THIN YTTRIA-STABILIZED ZIRCONIA LAYERS USING GLOW-DISCHARGE PLASMA

ZEMPACHI OGUMI, YOSHIHARU UCHIMOTO, YOICHIRO TSUJI, and ZEN-ICHIRO TAKEHARA (Kyoto University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 4, Aug. 15, 1992, p. 1577-1582. refs

(Contract MOESC-02203114; MOESC-02650585)

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A novel process of preparation of thin yttria-stabilized zirconia (YSZ) layers was developed. This process differs from other vapor-phase deposition methods in that a dc bias circuit, separate from the plasma-generation circuit, is used for the electrodeposition process. The YSZ layer was electrodeposited from ZrCl₄ and YCl₃ on a nonporous calcia-stabilized zirconia substrate. Scanning electron microscopy, electron probe microanalysis, electron spectroscopy for chemical analysis, and X-ray-diffraction measurements confirmed the electrodeposition of a smooth,

pinhole-free yttria-stabilized zirconia film of about 3-micron thickness. Author

A92-52736

DIRECT MONTE CARLO SIMULATION OF ATOMIC OXYGEN INTERACTION IN ACCELERATED GROUND SIMULATION

MASAHIRO ISHII (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan) and TAKASHI ABE (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 353-360. refs

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A numerical study was conducted on an accelerated ground simulator of the atomic oxygen interaction with materials in low earth orbits. The direct simulation Monte Carlo method was applied to obtain a flow property at the Knudsen number of 0.1. The dense flow that is required for accelerated material testing makes the collision effect between molecules important to analyze the experimental result obtained. The molecular collision leads to two phenomena in the flow near a material surface: (1) the obstruction of the atomic oxygen flux by reaction product and (2) the conversion of kinetic energy into thermal one. For these effects, the reaction rate of atomic oxygen in the accelerated material testing is reduced compared with that expected in a collisionless cold flow. This reduction is therefore remarkable for reaction having high threshold energy or a large steric factor. The result obtained in this study can explain an experimental discrepancy between the accelerated ground simulation and space tests using the STS. Author

A92-52788

NUMERICAL ANALYSIS OF GAS-SURFACE INTERACTION BY THE MOLECULAR DYNAMICS METHOD

YOICHIRO MATSUMOTO and JUN MATSUI (Tokyo, University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 889-896. refs

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The behavior of a gas molecule which collides onto a solid surface is simulated by the molecular dynamics method. A solid thin film, which consists of monatomic molecules, is formed and then a monatomic gas molecule collides onto the surface. The numerical results reveal that the scattering behavior of the gas molecule is neither specular reflection, diffuse reflection nor Maxwell model reflection. The scattered temperature of the gas molecule is correlated well to the relative initial power of the gas molecule to that of solid. The sticking probability has a good correlation with the ratio of the initial gas velocity and the potential well depth. Author

A92-52917

SOLUBILITY OF HYDROGEN IN METALS UNDER HIGH HYDROGEN PRESSURES - THERMODYNAMICAL CALCULATIONS

H. SUGIMOTO and Y. FUKAI (Chuo University, Tokyo, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, no. 9, Sept. 1992, p. 2327-2336. refs

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The solubility of hydrogen was calculated up to high hydrogen pressures for ten metals having small solubilities under normal pressures. For this purpose, the equation of state of hydrogen was calculated by the procedure of Hemmes et al., and the values obtained for the molar volume, the enthalpy, the Gibbs free energy and the entropy are tabulated in the range $p = 0.1$ MPa-100 GPa and $T = 400$ -2000 K. For solubility calculations, the chemical potential of hydrogen in solid solution was estimated from heats of solution observed at low hydrogen pressures and concentrations, by including a $p_v(H)$ term, and concentration-dependent terms arising from interactions between hydrogen atoms. The solubilities obtained for f.c.c. metals Al, gamma-Fe, Ni, Cu, Ag, Pt, Au and b.c.c. metals Cr, alpha-Fe, Mo, W are shown in the form of

25 INORGANIC AND PHYSICAL CHEMISTRY

Arrhenius plots with pressures as a parameter. Strong enhancements of the solubility over Sieverts' law are found at high hydrogen pressures. Author

A92-53355

CARBON-LITHIUM ANODES FOR LITHIUM SECONDARY BATTERIES

N. IMANISHI, S. OHASHI, T. ICHIKAWA, Y. TAKEDA, O. YAMAMOTO (Mie University, Tsu, Japan), and R. KANNO (Kobe University, Japan) *Journal of Power Sources* (ISSN 0378-7753), vol. 39, no. 2, July 1992, p. 185-191. Research supported by Nissan Science Foundation. refs
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For the development of a superior anode for practical lithium secondary batteries, the carbon-lithium composite anode is studied. As a carbon material, the carbon fiber M46 was mainly studied. This material was proved to be highly reversible in comparison with other carbon materials. It is shown that lithium ions and/or solvated lithium ions intercalate into the fiber by using X-ray diffraction and photoacoustic spectroscopy. Coupled with the Cr3O8 cathode, a coin-type cell was constructed. Over 170 cycles were possible when the M46 carbon-lithium composite anode was used, whereas with the bare lithium metal anode only 80 cycles were observed. Scanning electron micrographs show that the carbon fiber prevents the formation of dendritic lithium metal. Author

A92-53480

HYDROCARBON/NOX COMBUSTION IN SOLID ROCKET MOTOR

A. K. HAYASHI (Nagoya University, Japan), R. MORIYASU (East Japan Railways, Japan), and M. C. BRANCH (Colorado, University, Boulder) IN: *International Symposium on Space Technology and Science*, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 215-219. refs
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Numerical analysis is performed for a hydrocarbon/NO(x) flame to develop a better reaction mechanism using a steady, quasi-1D energy and species equations with a full chemical reaction mechanism and a full set of binary diffusion coefficients. A preliminary calculation for methane/oxygen/argon flame is performed to see whether the methane mechanism developed is feasible, and it is found that water yield is not predicted well, probably due to the experimental uncertainty. Numerical analysis of methane/nitrogen dioxide/oxygen flame shows that a developed mechanism predicts the flame, but nitrogen dioxide decomposition reaction rates have still some uncertainty and have to be improved further. Author

A92-53496

NUMERICAL SIMULATION OF A FLAME PROPAGATION AND ITS SELF-INDUCED FLOW IN A CLOSED DUCT

MANADU HISHIDA and KOICHI HAYASHI (Nagoya University, Japan) IN: *International Symposium on Space Technology and Science*, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 323-326. refs
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Flame propagation in a closed duct, a 'tulip' flame, is numerically simulated using time-dependent, 2D, full Navier-Stokes equations with the mass, energy, and species conservation equations for the hydrogen-oxygen mixture. A hydrogen-oxygen reaction mechanism is modeled by nine species and 19 elementary reversible reactions to evaluate the effect of chemical reaction accurately. To solve the governing equations without the stiffness of reaction, a semiimplicit predictor-corrector TVD scheme is applied in the present analysis. Author

A92-54460

IGNITION PROBABILITY IN A FUEL SPRAY

CHIHONG LIAO, KUNIO TERAQ (Yokohama National University, Japan), and YOSHIO UTAKA (Tokyo Institute of Technology, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2299-2303. refs
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The spatial and temporal distribution of the ignition probability in an n-octane fuel spray injected into high-temperature air (1270 K at 1.5 MPa pressure) behind reflected shock waves in a shock tube was investigated by dividing the spray space into 25 sections to observe the ignition in each section, using the equations of the stochastic ignition theory for calculations. Using several photomultipliers, the ignition and the motion of the injected wave were recorded in each section at the same time. The values of the ignition probability and the partial ignition probabilities for each section were obtained from the histograms of the ignition induction period in the total space and in the particular sections, respectively. The spatial distribution of the ignition probability could then be obtained from observations of the temporal variations of the partial ignition probabilities. I.S.

A92-54462

THE MOST INFLAMMABLE STATE OF A LEAN HYDROCARBON-AIR MIXTURE

KUNIO TERAQ and CHIHONG LIAO (Yokohama National University, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2308, 2309. refs
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The spontaneous ignition in an n-octane-air mixture with a fuel excess rate leaner than 0.4 behind reflected shock waves in a shock tube was investigated statistically. From the histogram of the ignition induction period, the ignition probability, the ignition development period, and the most inflammable state were examined. The results suggest that the higher the mixture temperature is, the leaner is the mixture of the most inflammable state. Author

N92-15138# Language Services, Knoxville, TN.

REMOVAL OF METAL IONS FROM AQUEOUS SOLUTION BY ELECTRODIALYSIS

YOSHIYUKI MIYAGI (Oak Ridge Y-12 Plant, TN.), TOMOKAZU TABATAKE (Oak Ridge Y-12 Plant, TN.), TOSHA KATAOKA (Oak Ridge Y-12 Plant, TN.), and KIMIYASU SATO (Tosoh Corp., Yamaguchi, Japan) 1991 13 p Prepared for Oak Ridge Y-12 Plant, TN
(Contract DE-AC05-84OS-21400)
(DE91-018439; Y/TR-91/21) Avail: CASI HC A03/MF A01

A method is described for removing metal ions by electrodialysis. This method is characterized by dosing an aqueous solution containing metal ions (using a chelating agent), allowing chelated compounds of specific metal ions to form in the aqueous solution, and then removing the ions that cannot be accommodated by the chelate formation from the aqueous solution. Those ions not accommodated by the chelate formation are metal ions of valence 1. DOE

N92-23456# New Energy Development Organization, Tokyo (Japan).

SURVEY ON FIXATION AND UTILIZATION OF CARBON DIOXIDE BY CATALYTIC HYDROGENATION

Mar. 1991 197 p In JAPANESE; ENGLISH summary
(DE92-769380; NEDO-ITE-9008) Avail: CASI HC A09/MF A03

This paper investigates a chemical method among CO₂ fixation technologies. The chemical fixation of CO₂ is basically reduction. It is well known that useful chemical intermediates such as methanol, ethanol, low grade hydrocarbon, etc. can be synthesized from CO₂ by catalytic hydrogenation. A large amount of energy is required for chemical separation of oxygen from CO₂. In the future methanol synthesis from CO₂ instead of CO is also expected to be commercialized. CO₂ reduction to hydrocarbon requires more hydrogen than CO reduction (Fischer-Tropsch method) but development of its new process hereafter will make fixation of a great deal of CO₂ possible. Various studies are made on electrochemical, photochemical and photosynthetic CO₂ reduction to hydrocarbon and on CO₂ reduction to methane by anaerobic bacteria. For chemical fixation and utilization of CO₂, it is not only needed to develop elemental technologies, but to make a comprehensive consideration of volume, energy, environment and economy. DOE

METALLIC MATERIALS

N92-25012 Osaka Univ., Suita (Japan). Dept. of Applied Physics.

MEASUREMENTS OF THE OPTICAL CONSTANTS OF SOME NEAR-MILLIMETER WAVE MATERIALS BY MEANS OF NON-DISPERSIVE FOURIER TRANSFORM SPECTROSCOPY

K. SAKAI (Osaka Univ. (Japan).), T. NAKANO (Osaka Univ. (Japan).), Y. ICHIOKA (Osaka Univ. (Japan).), and H. MATSUO (Nagoya Univ., Japan) In National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths 18 p Oct. 1991

Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

The complex refractive indices of several specimens are measured by means of the nondispersive Fourier transform spectroscopic technique in the region below 1.5 cm. Results are presented for X-cut crystal quartz, Rexolite, Macor, polyethylene, beryllium oxide and Ferroflow. The uncertainties of refractive index and absorption coefficients are estimated for each sample. It is concluded that the method proposed by Loewenstein and Smith using non-dispersive Fourier transform spectroscopy is effective in determining optical constants. ESA

N92-25798# Japan Atomic Energy Research Inst., Tokyo.
DEVELOPMENT OF A LASER INDUCED PHOTOACOUSTIC SPECTROSCOPY SYSTEM FOR ANALYTICAL TECHNIQUE OF NP ION IN THE PUREX PROCESS

TAKEHIRO KIHARA (Hitachi Ltd. (Japan).), SACHIO FUJINE (Hitachi Ltd. (Japan).), MITSURU MAEDA (Hitachi Ltd. (Japan).), TETSUYA MATSUI (Tokyo Univ. (Japan).), TETSUO FUKASAWA (Tokyo Univ. (Japan).), MASAHARU SAKAGAMI (Tokyo Univ. (Japan).), TAKASHI IKEDA (Tokyo Univ. (Japan).), and TAKEHIKO KITAMORI (Tokyo Univ., Japan) Sep. 1991 61 p In JAPANESE; ENGLISH summary

(DE92-768092; JAERI-M-91-142) Avail: CASI HC A04/MF A01

A new system of laser induced photoacoustic spectroscopy (LIPAS) has been developed for Np ions. The LIPAS system is composed of a YAG laser driven dye laser, a flow type cell with piezoelectric transducer (PZT), and digital storage oscilloscope. In the case of neodymium analysis, which was used as a simulant for Np ion, the detection limit absorptivity was $3.1 \times 10(\exp -5)/\text{cm}$ and the detection limit concentration was $4.4 \times 10(\exp -6)$ M. These values show that the sensitivity of the present LIPAS system is two orders higher than that of spectrophotometry. The system has been applied to analyze Np(V) in nitric acid. In order to protect PZT from corrosion, the surface of PZT was coated with poly-vinyl chloride. The detection limit absorptivity was $3.6 \times 10(\exp -5)/\text{cm}$ and the detection limit concentration was $1.8 \times 10(\exp -6)$ M for the system. These values are two orders lower than that of spectrophotometry. The photoacoustic (PA) signal of Np(V) ions is amplified by coexisting uranium ions. Magnitude of the amplification was reported to be inversely proportional to the specific heat of solution. It was found that the signal intensity of Np(V) in the Np-U solution agrees well with the multiplication product of specific heat of uranium and the PA signal of Np(V) for Np solution without uranium. The detection limit concentration of Np(V) for Np-U solution was $2.5 \times 10(\exp -6)$ M. This value indicates that the LIPAS system is able to determine Np(V) ions. The feasibility of the LIPAS system is studied. DOE

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

A92-12019

HYDROGEN-SOLUTE INTERACTION IN NICKEL-BASED DILUTE ALLOYS STUDIED BY INTERNAL FRICTION TECHNIQUE

O. YOSHINARI, K. SANPEI, and K. TANAKA (Nagoya Institute of Technology, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 39, Nov. 1991, p. 2657-2665. refs

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The internal friction has been measured for dilute Ni-M alloys (M = Ti, Si, Co, Cr, Cu, Fe, Mn, Pd, V) containing hydrogen over a temperature range from 60 to 400 K. An internal friction peak due to the interaction between substitutional solute atoms and interstitial hydrogen atoms (S-I peak, SIP) is observed around 160 K except for the Ni-Co alloy. Detailed measurements have been performed on the Ni-Ti alloy; the binding energy for the Ti-H pair, evaluated from the solute and hydrogen concentration dependence of the peak height, is smaller than 2 kJ/mol. The relaxation strength of the SIP is comparable to the Snoek peaks in b.c.c. metals, and is closely related to the dilatation of the host Ni lattice by alloying. Below 120 K, a background internal friction is observed in specimens which show the SIP. The background is explained in terms of the magnetomechanical damping accompanied by the hydrogen reorientation around solute atoms under a static stress due to magnetostriction. Author

A92-12622 Toyota Motor Co., Aichi (Japan).

SOLIDIFICATION OF HIGHLY UNDERCOOLED FE-P ALLOYS

M. SUZUKI (Toyota Motor Corp., Japan), T. J. PICCONE, M. C. FLEMINGS (MIT, Cambridge, MA), and H. D. BRODY (Pittsburgh, University, PA) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 22A, Nov. 1991, p. 2761-2768. refs

(Contract NAS3-4875; NAG8-826)

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Rapid solidification behavior of highly undercooled iron-phosphorus alloys was investigated by using a high-speed optical temperature measurement system. The experimental results on solidification rate as a function of bulk undercooling agree well with a model which includes a treatment of nonequilibrium effects during the solidification process. The model employs temperature-dependent values of equilibrium liquids slope, equilibrium solute distribution coefficient, and solute interdiffusion coefficient. Values of the kinetic parameters, $a(0)$ and $V(0)$, in the analysis which best fit the experimental results are $5 \times 10 \exp -10$ m and 600 m/s, respectively. Comparison of experimental results and theory suggests that a transition from local equilibrium to nonequilibrium solidification takes place with increasing undercooling and that interface kinetic effects become predominant at higher undercooling (or growth velocity). Author

A92-12624 Toyota Motor Co., Aichi (Japan).

MEASUREMENTS OF RAPID SOLIDIFICATION RATE IN HIGHLY UNDERCOOLED MELTS WITH A VIDEO SYSTEM

M. SUZUKI (Toyota Motor Corp., Japan), T. J. PICCONE, and M. C. FLEMINGS (MIT, Cambridge, MA) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 22A, Nov. 1991, p. 2825-2828. refs

(Contract NAS3-4875; NAG8-826)

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Results are presented of experiments using a video system for direct measurement of dendrite tip velocity in undercooled alloy melts, as well as findings of a comparison of results with those obtained from optical temperature measurements and with calculations using a dendrite growth model based on the analysis

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by Boettinger et al. (1988). The Fe-2 wt pct B and Fe-6 wt pct P alloys were used. Samples were prepared by high-frequency induction melting of iron pieces with either iron boride particles or iron phosphide particles. Experimental results for solidification rate (average of the different dendritelike tips) versus bulk undercooling for Fe-2 wt pct B and Fe-6 wt pct P, respectively, are presented. Measured velocities ranged from 0.0045 m/s at 24-K undercooling to 0.07 m/s at 175-K undercooling and from 0.014 m/s at 71 undercooling to 0.22 m/s at 247 undercooling for Fe-2 wt pct B and Fe-7 wt pct P, respectively. Experimental results obtained using the video system are close to those obtained via the optical temperature measurement system and also agree well with the calculated curves at higher undercoolings. C.A.B.

A92-13143

EFFECT OF FE AND MO ADDITION ON CRYOGENIC MECHANICAL PROPERTIES OF THE Ti-5 PERCENT AL-2.5 PERCENT SN ALLOY

N. YAMAGAMI, S. TSUYAMA, and K. MINAKAWA (NKK Corp., Kawasaki, Japan) IN: *Advances in cryogenic engineering - Materials*. Vol. 36, pt. B. New York, Plenum Press, 1990, p. 1193-1199. refs
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An analysis is made of the influence of the addition of Fe and Mo on the mechanical properties of the Ti-5 percent Al-2.5 percent Sn alloy in order to explain the effect of the second-phase $\alpha + \beta$ titanium alloys on its cryogenic mechanical properties. The addition of either Fe or Mo was found to result in a two-phase microstructure in a Ti-5 percent Al-2.5 percent Sn alloy. At cryogenic temperature, the Fe-added alloy exhibits a considerable reduction in ductility as well as toughness, whereas the addition of Mo maintains ductility and toughness, resulting in a good strength-ductility and toughness balance. A cross-sectional view of the fractured surface of each alloy showed that void formation of the 2 percent Fe-added alloy was localized at the retained beta phase near the fracture surface at cryogenic temperature. In the 2 percent Fe-added alloy, the athermal omega phase was found in the retained beta phase at cryogenic temperature, which could not be found in the 2 percent Mo alloy. The degradation of this alloy's toughness and ductility is explained in terms of the influence of the athermal omega phase. P.D.

A92-13441

SCATTERING IN STRESS CORROSION RESISTANCE OF RRA-TREATED 7475 ALUMINUM ALLOYS

TADAKAZU OHNISHI (Osaka Prefecture University, Sakai, Japan) and HIDEKI KUME (Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Sept. 1991, p. 582-589. In Japanese. refs

The stress corrosion cracking (SCC) resistance properties of conventionally treated and RRA-treated aluminum alloy sheets were examined. It was found that, while the SCC lives of the RRA-treated specimens varied widely, the minimum levels of lives of RRA-treated specimens were close to that of T6 specimens. Additional treatments, such as preaging at low or high temperatures or repetition of retrogression and reaging procedures produced insignificant improvement. On the other hand, considerable improvement of SCC resistance with high statistical reliability was obtained for specimens treated by the RRA condition containing an overaging retrogression process. I.S.

A92-13442

CASTABILITY OF AL-LI ALLOYS

SEIJI SAIKAWA, SHIGERU SUGIOKA, KIYOSHI NAKAI, YASUO SUGIURA (Asahi Tec Co., Ltd., Shizuoka, Japan), and AKIHIKO KAMIO (Tokyo Institute of Technology, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Sept. 1991, p. 596-601. In Japanese. refs

The casting characteristics of Al-3Si-1Mg-0.15Zr (in percent) containing 1, 2, or 3 percent Li were investigated. It was found that Li losses were about 0.1, 0.2, and 0.4 percent for alloys containing 1, 2, and 3 percent Li, respectively, when the alloys were melted and held for 3 ksec at 973 K in air. I.S.

A92-13443

EFFECT OF MECHANICAL ALLOYING ON THE PROPERTIES OF RAPIDLY SOLIDIFIED AL-MN BASE ALLOYS

HEE T. SHIN, MAKOTO SUGAMATA, and JUNICHI KANEKO (Nihon University, Narashino, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Sept. 1991, p. 607-613. In Japanese. refs

The effect of mechanical alloying (MA) on the properties of rapidly solidified Al-8 percent Mn alloy flakes containing Fe, Cr, Co, Ce, or Fe+Ni was investigated using rapidly solidified alloy flakes (produced by using an apparatus combining atomization and water-cooled single copper roll) which were MA processed for 30 hrs by a high-energy ball mill. Results indicate that the hardness, strength, and thermal stability of rapidly solidified Al-8Mn alloy were improved by the addition of a third element (with maximum improvement observed in alloy containing 4 percent Co). These properties were further improved by applying MA. I.S.

A92-13444

LIGHT METAL MATERIALS FOR AIRCRAFT STRUCTURE

TSUGIO IMAMURA (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Sept. 1991, p. 623-634. In Japanese. refs

Aircraft construction materials are presented, with particular reference to the structures of the MU-2J aircraft. Various materials are examined, including 2024-T3, 7075-T6, Ti-6Al-4V alloy, and ZK60A-T5. The static and fatigue strength of the materials is examined, and the metal working and thermal treatment of the materials are discussed. Y.P.Q.

A92-15177

DISLOCATION DENSITY AND INTERNAL STRESS IN SOLUTION-HARDENED AL-MG ALLOYS AT HIGH TEMPERATURES

HIDEHARU NAKASHIMA (Kyushu University, Fukuoka, Japan) IN: *Creep and fracture of engineering materials and structures; Proceedings of the 4th International Conference, Swansea, Wales, Apr. 1-6, 1990*. London, Institute of Metals, 1990, p. 41-50. Research supported by Light Metal Educational Foundation of Japan. refs
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A stress change test and a stress relaxation test for steady state deformation of 3-5 at. pct Mg containing aluminum alloys in the temperature range 573-723 K and the stress range 4.4-70 MPa are used to determine the internal stress in order to clarify the origin of internal stress in solution-hardened alloys deformed at high temperature. Dislocation density and structure are determined by TEM observations using Al-Mg alloys crept well into the steady state. It is found that many attractive junctions are formed by dislocations on different slip planes. The experimental relation between the internal stress and the dislocation density agrees with the theoretical one. It is concluded that the main origin of internal stress is the athermal stress needed for breaking the attractive junctions. C.A.B.

A92-15180

THRESHOLD STRESS FOR HIGH-TEMPERATURE CREEP IN SOME ALUMINIUM ALLOYS WITH INCOHERENT PARTICLE DISPERSIONS

SHOJI GOTO (Kyushu University, Fukuoka, Japan) IN: *Creep and fracture of engineering materials and structures; Proceedings of the 4th International Conference, Swansea, Wales, Apr. 1-6, 1990*. London, Institute of Metals, 1990, p. 131-140. Research supported by Light Metal Educational Foundation and MOESC. refs

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High-temperature creep behavior of some aluminum alloys with incoherent particles is studied in a range from 473 to 723 K and in a wide stress range covering both sides of calculated Orowan stress in order to examine the validity of Srolovitz's attractive interaction theory. A clear threshold stress is found to exist in the Al-Mg-Mn and Al-Be alloys, the value of the stress being approximately equal to the stress estimated from the attractive

interaction hardening, which is nearly equal to the value of the Orowan stress. In situ HVEM observation reveals that the dislocation-particle interaction is of an attractive type and no dislocation line is visible at the particle/matrix interface, indicating that the dislocation stress field is almost completely relaxed at the interface. The observed threshold stress is discussed from the viewpoint of the attractive interaction. It is shown that the previous threshold stresses in dispersion-hardened alloys are well explained by the attractive interaction. C.A.B.

A92-15181

SIGNIFICANCE OF LONG-TERM PROPERTIES IN THE EVALUATION OF INTERMETALLICS - CASE STUDY ON POLYCRYSTALLINE TiAl

HIROSHI OIKAWA and TOHRU TAKAHASHI (Tohoku University, Sendai, Japan) IN: Creep and fracture of engineering materials and structures; Proceedings of the 4th International Conference, Swansea, Wales, Apr. 1-6, 1990. London, Institute of Metals, 1990, p. 237-253. Research supported by Shinsei Shigen Kyokai. refs (Contract MOESC-63550522; MOESC-01460218) Copyright

A92-15186

ORIENTATION DEPENDENCE OF TENSILE PROPERTIES OF SINGLE CRYSTALS OF NI-BASE SUPERALLOYS

T. SAKAKI, K. KAKEHI, T. ADACHI, and T. TANAKA (Tokyo Metropolitan University, Japan) IN: Creep and fracture of engineering materials and structures; Proceedings of the 4th International Conference, Swansea, Wales, Apr. 1-6, 1990. London, Institute of Metals, 1990, p. 313-322. refs (Contract MOESC-62460076) Copyright

Results are presented of an investigation of the orientation and temperature dependence of the yield stress of two kinds of Ni-base superalloy single crystals. Tensile tests were performed at room temperature and up to 1000 C. Orientation dependence of proof stress below 700 C was different from that above 900 C. Below 700 C, octahedral slip systems were operative, except in the -111-line, and proof stress at each testing temperature was the minimum in the 012-line. Proof stresses in the orientations on the base of the standard stereo triangle were lower than those in the orientations on the oblique side. At 900 and 1000 C, operative slip systems were not specified, and the orientations on the base of the standard triangle showed higher proof stresses than the orientations on the oblique side. The maximum proof stress appeared in the 014-, 012-, -115-, or 001-lines. C.A.B.

A92-15497

DEFORMATION BEHAVIOR OF TINI SHAPE MEMORY ALLOYS - CYCLIC CHARACTERISTICS UNDER CONSTANT TEMPERATURE AND CONSTANT STRESS

HISAAKI TOBUSHI, KIMIO KIMURA (Aichi Institute of Technology, Toyota, Japan), KIKUAKI TANAKA (Tokyo Metropolitan Institute of Technology, Hino, Japan), TATSUYA HORI, and TAKAYUKI SAWADA Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 40, Oct. 1991, p. 1276-1282. In Japanese. refs Copyright

A92-15498

CRACK PROPAGATION OF OXIDE DISPERSION STRENGTHENED SUPERALLOY INCONEL MA754 IN CREEP-FATIGUE

RYUICHI OHTANI, TAKAYUKI KITAMURA (Kyoto University, Japan), and HIDEKI MIKI Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 40, Oct. 1991, p. 1297-1302. In Japanese. refs Copyright

Crack propagation behavior was examined in creep fatigue at high temperatures using center cracked plate specimens of an oxide dispersion-strengthened (ODS) superalloy Inconel MA754. The transverse crack propagation at 1273 K and 1173 K was strongly affected by the microstructure. The crack arrested temporarily at the grain boundaries perpendicular to the propagation

direction while it propagated fast at the midway. The average crack length through the thickness of the specimen, which included about 15 grains, increased smoothly without crack arrest and the propagation rate correlated well with the creep J-integral range. Little difference was observed in the dI/dN - ΔJ_c relations between Inconel MA754 and Nimonic 75. Crack propagation in Inconel MA754 was much slower than that in Nimonic 75. The high resistance of ODS superalloy against creep fatigue crack propagation was due to oxide dispersion. C.D.

A92-15511

NICKEL BASE SUPERALLOYS SINGLE CRYSTAL GROWTH TECHNOLOGY FOR LARGE SIZE BUCKETS IN HEAVY DUTY GAS TURBINES

AKIRA YOSHINARI, KATSUMI IJIMA, HIDEYO KODAMA (Hitachi, Ltd., Hitachi Research Laboratory, Japan), KIMIO KANO, and HIROYUKI MATSUZAKI (Tohoku Electric Power Co., Sendai, Japan) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 6 p. refs (ASME PAPER 91-GT-22)

A larger size bucket with superior high temperature strength is required for future land based gas turbines. From the viewpoint of high temperature mechanical properties, single crystal alloys are rather promising. To grow larger sized single crystals of nickel base superalloys, a two stage heating and bypass process in which single crystal growth paths are incorporated into large cross sectional positions such as platforms has been developed. It results in successful single crystal growth of alloys for buckets with a total length of 170 mm and large lateral cross section. Characteristics of single crystal buckets made by the bypass process and properties of an alumina mold prepared for a single crystal casting are described herein. Author

A92-17309

DELAYED FAILURE OF PH13-8MO STEEL PLATED WITH AL-IVD

Y. ASAYAMA (Nagoya Screw Manufacturing Co., Ltd., Japan), M. IBARAGI, and Y. KAWASE (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 22A, Dec. 1991, p. 2935-2945. refs Copyright

Experiments were carried out on samples made of PH13-8Mo steel plated with Al by an ion vapor deposition (IVD) process, in order to investigate the cause of the failure of aluminum-plated PH13-8Mo-steel bolts made for aircraft. Sustained load tests were performed in distilled water with notched specimens aged at 783 K. Results showed that (1) specimens containing more than 1.16 percent Al exhibited premature delayed failure with a low stress-level threshold; (2) specimens containing less than 1.16 Al and less than 0.025 percent carbon showed extensive scatter in the values of the threshold stress; and (3) specimens containing less than 1.16 percent Al and more than 0.025 percent carbon did not exhibit premature failure even at high stress levels, indicating that carbon in the steel inhibits the occurrence of delayed failure at high strength levels. I.S.

A92-18637

CHARACTERIZATION OF HIGH TEMPERATURE CREEP CRACK GROWTH AND CREEP LIFE FROM HIGH TEMPERATURE DUCTILE THROUGH TO HIGH TEMPERATURE BRITTLE MATERIALS

A. T. YOKOBORI, JR., TETSUO NISHIHARA (Tohoku University, Sendai, Japan), and TAKEO YOKOBORI (Teikyo University, Utsunomiya, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 737-748. refs Copyright

Equations are developed for the creep-crack growth and creep life for materials that spanning from high-temperature ductile

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through to high-temperature brittle. It was found that the high-temperature creep-crack growth rate is well characterized by the crack growth rate equation $da/dt = A \text{ times } e \exp Q^*$, proposed by Yokobori et al. (1980). It is shown that, using a unified formula based on the Q^* parameter concept, it is possible to predict or characterize the creep crack growth rate and the creep life, from high-temperature ductile materials such as Cr-Mo-V steel and SUS 304 stainless steel, to high-temperature brittle materials such as alumina ceramics. The effect of creep life can be discriminated by the material constants included in the equation. I.S.

A92-18650

INTERNAL CRACK INITIATION IN HIGH CYCLE FATIGUE AT CRYOGENIC TEMPERATURES

K. NAGAI, O. UMEZAWA, T. YURI, and K. ISHIKAWA (National Research Institute for Metals, Tsukuba, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers.. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 957-961, 963-965. refs Copyright

High-cycle fatigue properties of structural materials at the temperatures of liquid N₂ (77 K) and liquid He (4K) were investigated for titanium alloys Ti-5Al-2.5Sn and Ti-6Al-4V, the austenitic stainless steel SUS316LN, and high-manganese steels 0.1N-32Mn-7Cr and 25Mn-5Cr. Some of the test materials showed internal crack initiation that was not associated with pores or inclusions, which occurred in low peak stress test. Results of TEM examination identified a heterogenous dislocation structure in fatigued specimens with internal cracks for the Ti-5Al-2.5Sn alloy and the 32Mn-7Cr steel. It is suggested that a possible mechanism of internal crack initiation in weak structures may involve microcracking by stress or strain concentration due to localized deformation. I.S.

A92-18690

HYDROGEN SEGREGATION IN AN AL-LI ALLOY

GOROH ITOH, MOTOHIRO KANNO (Tokyo, University, Japan), and HIROSHI OKADA Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Jan. 1, 1992, p. 69-74. Research supported by Light Metal Educational Foundation, Inc. refs Copyright

The present study examines the distribution of impurity hydrogen in a binary Al-Li alloy by newly modified tritium autoradiography in which the alloy is charged with tritium during melting and casting. Due to the degassing treatment and the following hydrogen charging, the hydrogen content in the charged specimen is about three times that of the noncharged one, while the lithium content in the charged specimen is somewhat lower. The lithium content in the charged specimen is obviously within the range for the commercially available Al-Li alloys. The hydrogen content is also within the reported range from 7 molppm to 1100 molppm. It is thus expected that autoradiography in the specimen charged with tritium provides information on the behavior of hydrogen in the commercially available Al-Li alloys. P.D.

A92-18826

SUPERPLASTIC FORMING AND DIFFUSION BONDING OF 7475 ALUMINUM ALLOY SHEETS IN AIR

MITSUJI HIROHASHI, YOUN T. PARK, and HIROSHI ASANUMA (Chiba University, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Oct. 1991, p. 687-692. In Japanese. refs

Diffusion bonding of superplastic aluminum alloys has been generally carried out with insert materials or in vacuum, because the oxidized layer is too firm for diffusion bonding to take place. Diffusion bonding behavior of the superplastic 7475 aluminum alloy sheets was investigated without an insert material in air taking into account of the manufacturing process being easier by changing initial surface roughness, strain-rate, bonding pressure and time. Bonding was successfully performed at the thickness strain larger than 15 percent. Bonding strength proportionally increased with

increasing thickness strain. The value of bonding strength was maximized by adjusting the strain rate during forming to that of superplastic condition and with proper preparation of the initial surface roughness of the sheets. The maximum value obtained in this study was 40 percent of the original sheet. Author

A92-18827

DIFFUSION BONDING OF 7475 ALUMINUM ALLOY AND EVALUATION OF BONDING STRENGTH AND FATIGUE STRENGTH

YOSHIHARU MUTOH (Nagaoka University of Technology, Japan), MASARU KOBAYASHI (Chiba Institute of Technology, Narashino, Japan), MAKOTO TAKEMURA (Hitachi, Ltd., Yokohama, Japan), and HIDEO YOSHIDA (Sumitomo Light Metal Industries, Ltd., Nagoya, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Oct. 1991, p. 705-710. In Japanese. refs

Superplastic forming/diffusion bonding (SPF/DB) joints of 7475 aluminum alloy were produced, where various surface finishes and use of insert materials for removing surface oxide film were attempted. SPF/DB using a cryogenic rolling sheet of 7475 aluminum alloy brought better results of bonding and fatigue strength than that using a conventional cold rolling sheet. Surface finish was required to obtain high-quality bond, but Ag insert material enabled SPF/DB without surface finish for thin and weak oxide films. The 5052 aluminum alloy was not effective as the insert material. From the results of fatigue life prediction based on the fracture mechanics analysis, it was considered that the fatigue strength of the cryogenic rolling sheet bonded specimen was almost equivalent to that of the bulk specimen. Author

A92-18828

OPTIMIZATION OF FRICTION WELDING CONDITION OF 5056 ALUMINUM ALLOY

HIROSHI YAMAGUCHI, KOICHI OGAWA (Osaka Prefecture, University, Sakai, Japan), and KAZUHIKO SAKAGUCHI (Doshisha University, Kyoto, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Oct. 1991, p. 716-721. In Japanese. refs

The optimum welding condition for a 5056 aluminum alloy was investigated using a response surface method. The optimum welding condition to yield maximum tensile strength at the weld was attained through a steepest ascent path. A second-order equation predicting the weld strength accurately was established. The successful weld showed 89.2 percent joint efficiency in tensile strength. The optimum welding condition was obtained using a comparatively small burnoff. Therefore, the economical consideration such as a loss of material was not needed to be taken into account. The observation of the weld showed that the friction layer formed at the friction interface disappeared in the successful weld. Author

A92-19019

DEFORMATION AND FRACTURE BEHAVIOR OF A TIAL INTERMETALLIC COMPOUND IN COMPRESSION TESTS AT ROOM TEMPERATURE

KATSUHIKO NONAKA, KAZUO TANOSAKI, MASAYOSHI FUJITA, AKIHIKO CHIBA (Iwate University, Morioka, Japan), TAKESHI KAWABATA, and OSAMU IZUMI Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Oct. 1991, p. 1045-1053. In Japanese. refs

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In order to clarify the deformation and fracture behavior of a Ti-50 mol pct Al alloy, discontinuous compression tests have been performed at room temperature. Surfaces of specimens were observed by optical microscopy and scanning electron microscopy to reveal the formation of deformation bands, initiation sites and propagating routes of cracks, and fracturing process at every few percent of plastic strain by interrupting the tests. The compressive plastic strain at crack initiation is 2-3 percent, which is nearly twice as large as the tensile fracture strain reported in the other studies. From the observation of structural changes with cumulative strain, the modes of initiation and propagation of cracks are classified. Author

A92-19020**EFFECT OF SOLUTIONING CONDITIONS ON AGING RESPONSE IN Ti-15V-3Cr-3Sn-3Al**

HIDEKI FUJII and HIROWO G. SUZUKI (Nippon Steel Corp., Steel Research Laboratories, Futtsu, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Oct. 1991, p. 1063-1070. In Japanese. refs

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The precipitation and age hardening behavior of a beta titanium alloy, Ti-15V-3Cr-3Sn-3Al, was investigated experimentally as a function of solutioning conditions. It is found that the aging response is largely determined by the concentration of quenched-in vacancies, which is a function of the quenching temperature and density of the vacancy sinks. Thus, aging is accelerated in specimens quenched from high temperatures and characterized by low density of vacancy sinks. However, a precipitation delay and a denuded zone are sometimes observed in an area where vacancy sinks exist. In specimens quenched from the lower beta region and having smaller beta grain size or slightly higher density of dislocations, the delay of the aging process is significant, and alpha phase precipitation is heterogeneous. V.L.

A92-19021**EFFECT OF QUENCHED-IN VACANCIES ON MICROSTRUCTURES OF AGED Ti-15V-3Cr-3Sn-3Al**

HIDEKI FUJII and HIROWO G. SUZUKI (Nippon Steel Corp., Steel Research Laboratories, Futtsu, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Oct. 1991, p. 1071-1077. In Japanese. refs

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Specimens of a beta titanium alloy, Ti-15V-3Cr-3Sn-3Al, with high and low concentrations of excessive vacancies were used to investigate the effect of quenched-in vacancies on the microstructure. In specimens with high concentration of quenched-in vacancies, omega and alpha phases precipitate relatively homogeneously in the beta matrix regardless of dislocations at the early stages of aging. In the material with low concentration of excessive vacancies, the alpha phase nucleates at vacancy sinks, such as beta grain boundaries and dislocations. This material has a single age hardening peak at 400-500 C, whereas the material with high concentration of quenched-in vacancies has an additional peak at 300-350 C. V.L.

A92-19022**DISCONTINUOUS DEFORMATION OF AL-MG ALLOYS**

KATUO SAITOU, YASUO OTOGURO (Gumma University, Kiryu, Japan), and JUNJI KIHARA (Tokyo, University, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Oct. 1991, p. 1093-1101. In Japanese. refs

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The discontinuous deformation of Al-Mg alloys was investigated experimentally in the temperature range 243-473 K as a function of solute concentration (0.2-2.5 percent by mass) and grain size (40-500 microns). A parameter characterizing the relationship between the critical strain and the strain rate is shown to depend both on the solute concentration and grain size and increases with Mg concentration. This effect is discussed assuming that deformation-induced vacancies depend on the plastic strain. Activation energies for discontinuous deformation are determined. V.L.

A92-19075**FATIGUE CRACK PROPAGATION IN WELDED JOINTS UNDER RANDOM LOADING**

AKIHIKO OHTA, YOSHIO MAEDA (National Research Institute for Metals, Tokyo, Japan), SUSUMU MACHIDA, and HITOSHI YOSHINARI (Tokyo, University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 40, Nov. 1991, p. 1442-1446. In Japanese. refs

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The propagation characteristics are studied in air and in artificial sea water, and the results are compared to propagation rates computed analytically from constant-amplitude tests. The applied

and effective ranges of stress intensity are about the same due to increases in the stress ratio near the crack tip caused by residual tensile stresses. The fatigue threshold in air is 2x that corresponding to saline-solution testing, and the results of constant-amplitude testing can be used to estimate fatigue-crack propagation rates. C.C.S.

A92-19115**BICRYSTAL STUDY ON INTERGRANULAR STRESS-CORROSION-CRACKING**

M. YAMASHITA (Sumitomo Metal Industries, Ltd., Iron and Steel Research Laboratories, Amagasaki, Japan), S. HASHIMOTO, S. MIURA (Kyoto University, Japan), and T. MIMAKI (Doshisha University, Kyoto, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 32, Oct. 1991, p. 885-897. Research supported by Light Metal Educational Foundation of Japan and MOESC. refs

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Results of a study of the misorientation-dependent intergranular stress corrosion cracking (SCC) in a series of alpha Cu-Al alloy bicrystals are reported. It is shown that the experimentally observed variations in the susceptibility to intergranular SCC is correlated mainly with the boundary structure, energy, and dislocation behavior at the boundary. It is suggested that the differences in the interaction of dislocations with the boundary may also have an effect on large-angle boundaries. V.L.

A92-19116**AN ANALYTICAL ELECTRON DIFFRACTION TECHNIQUE FOR THE DETERMINATION OF LONG-RANGE ORDER PARAMETERS IN MULTI-COMPONENT ORDERED ALLOYS**

SYO MATSUMURA, KENSUKE OKI (Kyushu University, Kasuga, Japan), and TAKAO MORIMURA JIM, Materials Transactions (ISSN 0916-1821), vol. 32, Oct. 1991, p. 905-910. Research supported by Kazato Research Foundation. refs (Contract MOESC-01750660; MOESC-02855166)

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A combination of the channeling enhanced X-ray microanalysis (ALCHEMI) and the intersecting Kikuchi-line (IKL) method in transmission electron microscopy is used as a technique to determine long-range order (LRO) parameters of multicomponent alloys. This technique, IKL-ALCHEMI, opens up a field of research on atomic configuration in multinary alloys with imperfect order, taking advantage of a transmission electron microscope equipped with an EDX spectrometer. An application of IKL-ALCHEMI to L1(0)-type ordering in CuAuPd ternary alloys has successfully quantified occupation probabilities of the three elements on the two sublattices as a function of alloy composition. Author

A92-19666**RECOVERY AND RECRYSTALLIZATION OF COLD-ROLLED POLYSYNTHETICALLY TWINNED (PST) CRYSTALS OF TiAl**

M. H. OH, H. INUI, A. NAKAMURA, and M. YAMAGUCHI (Kyoto, University, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, Jan. 1992, p. 167-176. Research supported by MOESC and R & D Institute of Metals and Composites for Future Industries. refs

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The recovery and recrystallization behavior of cold-rolled polysynthetically twinned (PST) crystals of TiAl with an early stoichiometric composition was investigated as a function of reduction in thickness and subsequent annealing time at 900 and 1000 C. The change in microhardness was found to occur in two stages regardless of the amount of reduction; the first stage is associated with the decrease in dislocation density, and the second stage is related to the annealing-out of deformation twins introduced in TiAl lamellae during rolling. However, the recrystallization mode was found to vary depending on the amount of reduction in thickness. In specimens rolled to less than 20 percent reduction in thickness, the full recovery in hardness occurs preserving the lamellar structure. In contrast, in specimens rolled to more than 40 percent, a structure composed of equiaxed grains of TiAl is

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obtained after recrystallization. A mechanism is proposed to interpret the unusual recrystallization behavior of PST crystals of TiAl cold-rolled to less than 20 percent. Author

A92-19685

ANISOTROPY OF FATIGUE PROPERTIES IN COLD-ROLLED TITANIUM PLATE

M. SUGANO and T. SATAKE (Yamagata University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 185-190. refs
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The influence of texture on fatigue properties of titanium has been studied by testing the longitudinal and transverse specimens prepared from the unidirectionally cold-rolled plate. The significant anisotropy was observed in the fatigue life and the gradient of fatigue crack growth rate curve between the specimens. It was shown that the fatigue properties in textured polycrystalline titanium can be explained qualitatively in terms of a bicrystal model containing the two grains with basal plane parallel to the rolling direction but inclined to the rolling plane. Fatigue crack growth mechanism in the unidirectionally cold-rolled specimen are discussed in association with microstructural changes during cyclic stressing. Author

A92-19687

FATIGUE STRENGTH AND CRACK INITIATION OF Ti-6Al-4V

S. NISHIDA, C. URASHIMA, and H. G. SUZUKI (Nippon Steel Corp., Kitakyushu, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 197-202. refs
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Fatigue behavior of a Ti-6Al-4V alloy was studied in the wide high-cycle range. The fatigue strength of this alloy shows much scattering and notch insensitivity. Fracture has still occurred in the higher cycle range than 10×10^7 cycles and the distinct fatigue limit is not observed in this alloy. No microcracks exist in the specimen subjected to stress cycles of 1.0×10^9 , though many slip bands are observed at the surface of this specimen. Author

A92-19690

INTERNAL CRACK INITIATION IN HIGH CYCLE FATIGUE OF Ti-6Al-4V ALLOYS AT CRYOGENIC TEMPERATURES

O. UMEZAWA, K. NAGAI, and K. ISHIKAWA (National Research Institute for Metals, Tsukuba, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 267-272. refs
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As the maximum stress is decreased, the morphology of subsurface crack initiation site changes from consisting-of-a-single-facet to of-many-facets. The facet was identified as a cracked alpha phase by its morphology and composition analysis. The lower the maximum stress, the larger the size of subsurface crack initiation site. Using the size of the projection of the subsurface crack initiation site on the main crack propagating plane as a shape parameter, the size of the subsurface crack initiation site can be related unequivocally to the maximum stress regardless of impurity concentration, microstructure, and temperature. The dependence of initiation site size on the maximum stress can be accounted for by an assumption that the microcrack growth is controlled by a threshold condition. Author

A92-19707

FATIGUE BEHAVIOR OF A SURFACE CRACK UNDER MIXED MODE LOADING

K. TOHGO (Shizuoka University, Japan), A. OTSUKA (Nagoya University, Japan), and M. YOSHIDA (Nissan Motor Co., Ltd., Tokyo,

Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 567-572. refs

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Fatigue crack growth behavior from a semielliptical surface crack under shear loading has been investigated on weldable structural steel SM41A and aluminum alloy 2017-T4. Macroscopically, two kinds of crack growth morphology, tensile mode growth and shear mode growth, were observed. SM41A showed the tensile mode growth with complicated three-dimensional crack surfaces, and 2017-T4 showed the shear mode growth which occurred in the same plane as a precrack. The macroscopic shapes of these crack surfaces have shown good agreement with those predicted by the sigma(max)-criterion and the tau(max)-criterion, respectively. It is found that the behavior of the shear mode fatigue crack growth from a semielliptical surface crack in 2017-T4 can be predicted from the mode II and mode III fatigue crack growth properties. Author

A92-19756

SMALL FATIGUE CRACK GROWTH BEHAVIOUR AND ITS STATISTICAL PROPERTIES IN A PURE TITANIUM

K. TOKAJI, T. OGAWA (Gifu University, Japan), Y. KAMEYAMA (Brother Industries, Ltd., Nagoya, Japan), and Y. KATO (Daido Institute of Technology, Nagoya, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1091-1096. refs
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The growth behavior of small cracks and their statistical properties were studied under rotating bending in pure titanium. Small cracks grow much faster than, and even below the threshold values of ΔK_{th} and $\Delta K_{eff,th}$ for large cracks. The early growth is markedly affected by the microstructure in the region of crack length below 450 microns (a microstructurally small crack). Almost all of Stage I facet depths observed are of grain size, thus Stage I cracks do not correspond to microstructurally small cracks. The growth rates follow log-normal distributions independent of K_{max} or crack size. The coefficients of variation decrease with increasing K_{max} and then reach a constant value. The largest scatter is obtained at a crack depth comparable to the grain size. Author

A92-19762

STAGE I FATIGUE CRACK GROWTH AND INTERACTION WITH GRAIN BOUNDARY IN DIRECTIONALLY SOLIDIFIED Ni-BASE SUPERALLOY AND Al-Li ALLOY AT ELEVATED TEMPERATURES

M. OKAZAKI, S. YAMAHIRA, and T. TABATA (Nagaoka University of Technology, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1127-1132. refs
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Stage I fatigue crack growth is quantitatively studied in some directionally solidified Ni-base and Al-Li alloys at elevated temperatures by using the replication technique. The rate of stage I crack growth, when not influenced by a nearby grain boundary, proportionally increased with crack length. However, as the crack tip neared a grain boundary, the rate rapidly decreased. The stage I crack growth rate showed a good correspondence with the crack tip sliding displacement. The results thus obtained are also compared with the long crack growth rates in polycrystalline solids. Author

A92-19778

ANALYSIS OF FATIGUE CRACK SURFACE PARTIAL CONTACT IN RESIDUAL STRESS FIELDS

AKIRA TODOROKI, HIDEO KOBAYASHI, HARUO NAKAMURA,

and YOSHIO ARAI (Tokyo Institute of Technology, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1319-1324. refs

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To predict fatigue crack growth rate in residual stress fields, a linear fracture mechanics has been applied with a superposition technique. This approach is needed to calculate a residual stress intensity factor. It is, however, pointed out that if the crack grows in the compressive residual stress field, crack surface partial contact will occur because of compressive residual strain relief. Therefore, an effect of contact stress intensity factor must be considered. A simple approach to calculate the contact stress is proposed and the effect on fatigue crack growth is shown.

Author

A92-19786

FATIGUE CRACK GROWTH RATE DIAGRAMS OF ALUMINUM ALLOY A5083P-O UNDER RANDOM LOADING WITH AN EXPONENTIAL DISTRIBUTION

Y. TOMITA, K. HASHIMOTO (Osaka University, Suita, Japan), and H. SAKATA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 3. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1517-1522. refs

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Fatigue crack growth rate diagrams of aluminum alloy under random loading with an exponential distribution were obtained, using an original method. This method is based on random loading fatigue tests plus on equation based on a novel assumption. Other estimation methods introduced by different researchers were not applicable for the present experimental results. In addition, crack opening points were found to be constant during random loading cycles of each random loading fatigue test. Threshold stress intensity factors under random loading cycles were higher values than ones under constant amplitude loading cycles.

Author

A92-19789

VERY HIGH TEMPERATURE FATIGUE OF A NI-BASE SUPERALLOY

Y. NAKASONE, K. HIRAGA, and T. TANABE (National Research Institute for Metals, Tsukuba, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 3. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1553-1558. refs

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The present paper investigates the fatigue of a solid-solution-strengthened Ni-base superalloy, Ni-23 pct Cr-18 pct W alloy known as SSS113MA, at very high temperatures. Low-cycle fatigue tests of the alloy were carried out at room temperature, 1073 and 1273 K mainly in vacuum in fully reversed uniaxial displacement control. The total strain range vs fatigue life diagrams obtained from the tests at the three levels of temperatures are compared, and effects of temperature on the fatigue properties of the alloy are discussed. Fatigue strength decreases as temperature becomes higher. Striations were found in fatigue at room temperature and at 1073 K, whereas intergranular fracture occurred in fatigue at 1273 K.

Author

A92-19811

STRAIN SYNCHRONIZED POLARIZATION CURRENT ANALYSIS ON TI ALLOY IN 0.9 PERCENT NaCl SOLUTION DURING POTENTIOSTATIC CORROSION FATIGUE TEST

M. ONO, M. SHIMOJO, Y. HIGO, and S. NUNOMURA (Tokyo Institute of Technology, Yokohama, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering

Publications, Ltd., 1990, p. 2019-2024. refs

Copyright

Polarization-current perturbation which was synchronized with applied load was measured during a potentiostatic corrosion-fatigue test. The frequency component which was identical to the load-wave frequency was separated from the obtained current using FFT analysis, and the resultant current was termed 'SSPC'. The SSPC increased rapidly with progressing the fatigue damage such as crack propagation. It is considered that this SSPC increase was directly related to the increase of emerged fresh surface. The relation between fatigue-crack-propagation rate, repassivation of fresh surface at the crack tip, and both the phase and amplitude components of SSPC are discussed.

Author

A92-20075

ELASTICITY OF NI-BASED L1(2)-TYPE INTERMETALLIC COMPOUNDS

H. YASUDA, M. KOIWA (Kyoto University, Japan), and T. TAKASUGI (Tohoku University, Sendai, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, Feb. 1992, p. 381-387. refs

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The three elastic stiffness constants of various Ni-based intermetallic compounds Ni₃X (X = Mn, Fe, Al, Ga, Ge and Si) with L1(2) structure have been determined at room temperature by the rectangular parallelepiped resonance method. The elastic anisotropy factor, A, of the compounds is generally large, ranging from 2.5 to 3.3, except for Ni₃Ge (A = 1.71). The large anisotropy is believed to be responsible at least partly for the positive temperature dependence of the flow stress observed for these compounds. The elastic constants exhibit some correlation with the lattice constants. The minor element X, can be regarded as exerting 'chemical pressure' which causes the expansion of the Ni lattice, thus resulting in the decrease of the elastic constants.

Author

A92-21262

HIGH STRAIN RATE SUPERPLASTICITY IN AN AL-NI-MISCH METAL ALLOY PRODUCED FROM ITS AMORPHOUS POWDERS

K. HIGASHI, T. MUKAI, S. TANIMURA (Osaka Prefecture, University, Sakai, Japan), A. INOUE, T. MASUMOTO (Tohoku University, Sendai, Japan), K. KITA, K. OHTERA, and J. NAGAHORA (Yoshida Kogyo, Technical Research Laboratories, Toyama, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Jan. 15, 1992, p. 191-196. refs

Copyright

The detection is reported of high-strain-rate superplasticity in a new aluminum-based crystalline alloy, an as-extruded Al-Ni-Mm (Mm = misch) alloy which was fabricated by warm consolidation of its amorphous powders and was developed to be a very fine-grained structure of 70 nm in size, with a very uniform distribution of both Al₃Mm and Al₃Ni particulates of 70 nm. The maximum elongation of 540 pct was recorded at 0.7 s and 873 K, at which a high m value of 0.5 was obtained. The superplastic strain rate for the Al-Ni-Mm alloy was many orders of magnitude higher than that for typical superplastic alloys. This result shows a new possibility for the development of high strain rate superplasticity in aluminum-based alloys fabricated by warm consolidation of their amorphous powders.

C.A.B.

A92-21706

IMPROVEMENT IN OXIDATION RESISTANCE OF THE Ti-31 TO 39 MASS PCT AL ALLOYS BY HEAT TREATMENT UNDER A LOW PARTIAL PRESSURE OXYGEN ATMOSPHERE

MICHIKO YOSHIHARA (Yokohama National University, Japan), RYOHEI TANAKA (Japan Ultra-High Temperature Materials Research Center, Ube), TETSUYA SUZUKI, and MORIYASU GOTO JIM, Materials Transactions (ISSN 0916-1821), vol. 32, Nov. 1991, p. 1017-1023. Research supported by MOESC. refs

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The oxidation behavior of Ti-31 to 39 mass pct Al and Ti-36

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mass pct Al, with various oxygen contents, is presently investigated with a view to the effect of heat treatment under low oxygen partial pressure. Cyclic oxidation tests were conducted at 900 and 950 C in an air atmosphere. It is found that nonheat-treated specimen oxidation behavior depends on Al content, with oxidative mass gain decreasing with rising Al content. At 700 C, TiO₂ emerged in alloys with higher oxygen content. O.C.

A92-21924

REACTION MECHANISM OF COMBUSTION SYNTHESIS OF TIAL INTERMETALLIC COMPOUND

ATSUSHI HIBINO and RYUZO WATANABE (Tohoku University, Sendai, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Nov. 1991, p. 1256-1262. In Japanese. refs Copyright

The reaction mechanism of combustion synthesis of a TiAl intermetallic compound was analyzed by the observation of the reaction process in Ti and Al mixed-powder compacts and by a model calculation of the reaction kinetics. A premix of Ti and Al powders was vacuum-heated in an electric furnace to cause self-sustaining reaction. The measurement of the rise in the temperature, the observation of microstructural evolution involved in the reaction process and X-ray phase analysis of the product were performed. It was observed that at the melting point of Al, Al melt surrounded Ti particles and the reaction started and proceeded toward the center of the Ti particle. The synthesis reaction was analyzed using a spherical shell model which takes into account the microstructural change. The analysis shows that the reaction is accelerated with reaction time, which is in accordance with the observed self-sustaining reaction. The relative contribution of the diffusion of Al in TiAl and the interface reaction between TiAl and Ti was also quantified in terms of dependence on the Ti particle size. Author

A92-23316

DETERMINATION OF SITE OCCUPATION PROBABILITY OF CU IN Ni3Al BY ATOM-PROBE FIELD ION MICROSCOPY

K. HONO, A. CHIBA, T. SAKURAI, and S. HANADA (Tohoku University, Sendai, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, March 1992, p. 419-425. refs Copyright

The site preference of Cu in Ni₃Al with a composition of Ni₇₅Al₂₃Cu₂ has been determined by atom-probe field ion microscopy. The sample was analyzed in the three major low index planes with atomic layer resolution. From the data chain obtained in the 001 line direction the site occupancy of Cu atoms was determined by analyzing whether they were evaporated from the NiAl mixed planes or the Ni pure planes. It has been determined from an extensive number of quantitative data that the fraction of the Cu atoms in the Ni sites of the Ni₇₅Al₂₃Cu₂ intermetallic compound is 94 ± 6/-10 percent. The present finding substantiates the recently proposed mechanism which explain the ductilization of Ni₃Al by adding a few atomic percent of transition elements, such as Pd and Cu. Author

A92-23322

MULTIAXIAL CREEP OF A NICKEL-BASE DIRECTIONALLY SOLIDIFIED ALLOY - ANISOTROPY AND SIMULATION

N. OHNO (Nagoya University, Japan), T. MIZUNO (Mitsubishi Heavy Industries, Ltd., Nagoya Guidance and Propulsion Systems Works, Komaki, Japan), H. KAWAJI (Yamaha Corp., Electronic Metals Div., Iwata, Japan), and I. OKADA (Mitsubishi Heavy Industries, Ltd., Takasago, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, March 1992, p. 559-567. Research supported by Nitto Foundation. refs (Contract MOESC-01550070) Copyright

Combined tension-torsion creep tests of a nickel-base directionally solidified alloy are performed at 850 C using thin-walled tubular specimens with 001-line oriented in the axial direction. Effects of anisotropy are observed conspicuously on the magnitude of creep rate, but not so markedly on the noncoaxiality between creep rate and stress. To discuss this anisotropic feature, the

experimental data of minimum creep rate are compared with the crystal creep analyses of a single crystal element and a 2D directionally solidified plate model. It is shown that the experiments are simulated well if simultaneous operation of the 111-plane/112-line octahedral and 100-plane/110-line cubic slip-systems is assumed, and that the plate model is successful if it is based on an admissible stress field. Author

A92-24831

INCLUSION SIZE EFFECT ON THE FATIGUE CRACK PROPAGATION MECHANISM AND FRACTURE MECHANICS OF A SUPERALLOY

TAKESHI DENDA (Nippon Mining Co., Tokyo, Japan), PETER L. BRETZ, and JOHN K. TIEN (Texas, University, Austin) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 23A, Feb. 1992, p. 519-526. refs Copyright

Low cycle fatigue life of nickel-base superalloys is enhanced as a consequence of inclusion reduction in the melt process; however, the functional dependencies between fatigue characteristics and inclusions have not been well investigated. In this study, the propagation mechanism of the fatigue crack initiated from inclusions is examined in fine-grained IN718, which is a representative turbine disk material for jet engines. There is a faceted-striated crack transition on the fracture surfaces. This faceted-striated transition also appears in the da/dN vs crack length curves. It is observed that the faceted crack propagation time can be more than 50 pct of total lifetime in the low cycle fatigue test. The significance of inclusion size effect is explained on the premise that the faceted fatigue crack propagation time scales with the inclusion size, which is taken as the initial crack length. A predictive protocol for determining inclusion size effect is given. Author

A92-25032

COLD ROLLING OF BORON-FREE POLYCRYSTALLINE Ni3Al GROWN BY UNIDIRECTIONAL SOLIDIFICATION

TOSHIYUKI HIRANO and TOSHIO MAWARI (National Research Institute for Metals, Tsukuba, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, Feb. 15, 1992, p. 597-600. refs Copyright

The possibility of cold-rolling polycrystalline Ni₃Al grown by the floating zone method of unidirectional solidification was investigated experimentally. It is shown that unidirectionally solidified Ni₃Al can be cold-rolled to 25-percent reduction without the use of ductility enhancing elements. The grain boundaries are found to be resistant to cracking. It is concluded that floating-zone unidirectional solidification is a promising method from the standpoint of improving the room-temperature ductility of Ni₃Al. V.L.

A92-26115

SCALING STRUCTURE OF PIT PROFILE IN PITTING CORROSION

TAKASHI NAGATANI (Shizuoka University, Hamamatsu, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 3997-4000. refs Copyright

A growth model is presented to simulate pit formation in pitting corrosion in three dimensions. The pit-growth model is described in terms of the anti-diffusion-limited aggregation (anti-DLA) model. Computer simulation is performed to study the scaling structure of a single pit in pitting corrosion. It is found that the bird's-eye view of the corrosion pit profile shows a compact structure having a fractal surface. The fractal dimension D of the surface of the bird's-eye profile of the corrosion pit is given by D = 1.168. It is also found that the width and depth of the corrosion pit show a scaling form. The width w and depth h of the pit scale as w of approximately equal to n exp 0.39 ± 0.04 and h of approximately equal to n exp 0.28 ± 0.04 where n is the particle number

removed from metal. The width w against depth h scales as w of approximately equal to $h \exp 1.39 \pm 0.05$. Author

A92-26130
DESIGN AND DEVELOPMENT OF NI-BASE ODS
SUPERALLOYS

MICHIO YAMAZAKI, YOZO KAWASAKI, and KATSUYUKI KUSUNOKI (National Research Institute for Metals, Tokyo, Japan) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 33-39. Research sponsored by Agency of Industrial Science and Technology. refs

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The present authors were in charge of proposing new high gamma-prime Ni-base oxide dispersion-strengthened (ODS) superalloys prepared by mechanical alloying. This was done in a national project performed from 1982 to 1989, in which four types of advanced alloys were treated. One of the strongest conventionally-cast alloys previously developed was modified by using this program, and this led to an ODS alloy, TMO-2, which is stronger than MA6000. To improve the intermediate temperature strength of TMO-2, the effect of gamma-prime phase volume fractions was investigated. The effects of the phase volume fraction on recrystallization properties, which are important in obtaining optimal grain structures, as well as on creep rupture strength, are described. Author

A92-26131
GRAIN GROWTH OF GAMMA-PRIME STRENGTHENED
NI-BASE ODS ALLOY

NOBORU UENISHI and YOSHINOBU TAKEDA (Sumitomo Electric Industries, Ltd., Itami, Japan) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 41-48. Research sponsored by Agency of Industrial Science and Technology. refs

Copyright

An experimental characterization is presented for grain growth in the gamma-prime-strengthened, Ni-base, oxide dispersion-strengthened alloy TMO-2. Both mechanical alloying and hot powder extrusion were applied; alloy grain-growth properties during annealing were ascertained via TEM, XRD, and electron-channeling patterns. Stored energy, which had been introduced into the billets during hot-powder extrusion, clearly affected grain growth. In addition, the contamination of the mechanically alloyed powders by oxygen, nitrogen, and iron, was found to restrict grain growth. O.C.

A92-26132
ISOTHERMAL FORGING OF OXIDE DISPERSION
STRENGTHENED NICKEL BASE SUPERALLOY BLADES

OSAMU TSUDA, TOMIHARU MATSUSHITA, NOBUO KANAMARU, and KUNIIHIKO NISHIOKA (Kobe Steel, Ltd., Technical Development Group, Japan) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 49-55. Research sponsored by New Energy and Industrial Technology Development Organization. refs

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A novel process has been developed for the fabrication of oxide dispersion-strengthened Ni-base superalloy turbine blades with air-cooling passages, involving the net-shape forging of two major components followed by their bonding. Attention has been given to postforging recrystallization behavior and associated mechanical properties; numerical simulations were conducted via rigid-plastic FEM. The deformation process shows that plate-shaped preforms are desirable in order to achieve the requisite uniformity of strain, as well as to ensure grain-growth characterization. O.C.

A92-26133
ISOTHERMAL FORGING AND SUBSEQUENT TREATMENT OF
A NEWLY DEVELOPED ODS ALLOY FOR TURBINE BLADE
APPLICATIONS

JUNJI TSUJI and KAZUAKI MINO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 57-65. Research sponsored by Agency of Industrial Science and Technology. refs

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A new oxide-dispersion-strengthened alloy, TMO-2, has much higher creep strength than MA 6000. Isothermal forging, directional recrystallization, and diffusion bonding of TMO-2 have been developed for turbine blade applications. This paper summarizes secondary recrystallization behaviors of TMO-2 and fundamentals of microstructural control during isothermal forging and subsequent zone annealing. Introduction of dislocations by diffusion-brazing is also described, relating to poor joint strength which can be a serious problem for manufacturing air-cooled blades. Author

A92-26146
ORIGIN OF THE STRENGTH OF MECHANICALLY ALLOYED
ALUMINUM ALLOYS

TADASHI HASEGAWA (Tokyo University of Agriculture and Technology, Koganei, Japan) and TSUNEMASA MIURA (Showa Aluminum Corp., Oyama Works, Japan) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 213-219. Research supported by Light Metals Educational Foundation of Japan and MOESC. refs

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TEM and SEM are presently used to ascertain the stress vs strain behavior of mechanically-alloyed (MA) Al-base compositions containing SiC or Al₂O₃ particles of several 100s of nm in size, which were blended-in during the MA process, and Al-oxide and carbide particles of several 10s of nm in size that were formed during MA processing. It is found that most of the microstructural dislocations in these alloys were pinned down by the fine dispersoids; the high stress needed for the detachment of the dislocations from the fine dispersoids yielded high yield strength at low temperatures. The fine-scale dispersoids also suppressed the annihilation of the dislocations during high temperature exposure, with consequent loss of ductility. O.C.

A92-26147
DEFORMATION OF MECHANICALLY ALLOYED AL-TiB2
ALLOYS AT ELEVATED TEMPERATURES

M. OTSUKA, T. ISHIHARA (Shibaura Institute of Technology, Tokyo, Japan), MAKOTO SUGAMATA, and J. KANEKO (Nihon University, Narashino, Japan) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 221-228. Research supported by Light Metals Educational Foundation of Japan. refs

(Contract MOESC-01550061)

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The mechanical behavior and microstructural stability in the temperature range between 293 and 873 K have been investigated on three MA Al-TiB₂ alloys containing 2, 5 and 10 vol pct of TiB₂ in order to evaluate their capability as the structural materials for high temperature use. Compression tests and microhardness tests were performed on the alloys in the as-extruded conditions. The microstructure of each alloy is stable up to about 673 K. The effect of TiB₂ addition on the yield stress is remarkable only in the content range below 2 vol pct TiB₂. The yield stress decreases approximately in a linear manner with test temperature. Author

A92-26148
MECHANICALLY ALLOYED 2219 ALUMINUM ALLOYS
CONTAINING NON-METALLIC DISPERSOIDS

JUNICHI KANEKO, MAKOTO SUGAMATA (Nihon University, Narashino, Japan), and SU-GUN LIM (Dong-A University, Pusan,

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Republic of Korea) IN: Structural applications of mechanical alloying; Proceedings of the ASM International Conference, Myrtle Beach, SC, Mar. 27-29, 1990. Materials Park, OH, ASM International, 1990, p. 229-235. Research supported by MOESC. refs

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Improved mechanical properties are obtainable in Al alloys of 2219 composition via mechanical alloying and powder-consolidation processing which involves the addition of Al_2O_3 , SiC , TiC , and AlC during high-energy ball milling. The P/M materials thus obtained upon vacuum degassing and hot extrusion exhibited high strength at room and higher temperatures in the as-extruded condition; T6 tempering, however, exhibited minor strength increases relative to the ingot-metallurgy 2219 alloy. O.C.

A92-26490

SUPERPLASTIC BEHAVIOR AT HIGH STRAIN RATES OF A MECHANICALLY ALLOYED AL-MG-LI ALLOY

K. HIGASHI, T. OKADA, T. MUKAI, and S. TANIMURA (Osaka Prefecture, University, Sakai, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 26, March 1, 1992, p. 761-766. refs

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The tensile behavior of a mechanically alloyed (MA) Al-Mg-Li alloy with ultrafine, 400-nm mean size grain structure is presently characterized at various strain rates and temperatures, in order to analyze the possible mechanisms of high strain-rate superplasticity in Al base MA alloys. Tensile elongations of about 200 percent were obtained at very high strain rates (1-100/s), at temperatures above 823 K. The value of strain-rate sensitivity increased from 0.3 to 0.5 with rising test temperature. O.C.

A92-26521

STRUCTURAL TRANSITION IN PITTING CORROSION OF BINARY ALLOYS

TAKASHI NAGATANI (Shizuoka University, Hamamatsu, Japan) Physical Review A (ISSN 1050-2947), vol. 45, Feb. 15, 1992, p. 2480-2484. refs

Copyright

A growth model is proposed to simulate the pit formation in pitting corrosion of binary alloys. The metal is modeled by a random binary alloy where one species is easy to dissolve and the other species is hard to dissolve. The pit growth model is described by the antidiffusion-limited aggregation model. A computer simulation is performed to form the corrosion pit in two dimensions for various composition ratios. It is shown that, at the percolation threshold, a structure transition of the corrosion pit occurs between the diffusion-limited corrosion and the dissolution-limited corrosion. Above the percolation threshold of easily dissolving species, the pitting corrosion is controlled by the diffusion of anions and the width w of the pit scales as w equal to about $h \exp(1.86 \pm 0.05)$, where h is the depth of the pit. Below the percolation threshold, the pitting corrosion by dissolution of metal and the width w of the pit is proportional to the depth h of the pit. Author

A92-26707

COMBUSTION SYNTHESIS OF INTERMETALLIC COMPOUNDS

YOSHINARI KAIEDA, MINORU OTAGUCHI, and NOBUTAKA OGURO (National Research Institute for Metals, Tokyo, Japan) IN: Combustion and plasma synthesis of high-temperature materials. New York, VCH Publishers, 1990, p. 106-113. refs

Copyright

A new process for the production of shape-memory alloy from elemental powder is proposed. The process consists of mixing the elemental powders, forming the mixed powders with a cold isostatic press, applying combustion synthesis, sintering with HIP, and plastic working. The process is probably the first successful trial to produce NiTi wire, tube, and sheet from elemental powders. The mechanical properties and the shape-memory effect of the wire are similar to conventionally produced NiTi wire. C.D.

A92-26912

DYNAMIC RECRYSTALLIZATION AND SUPERPLASTICITY OF 7475 ALUMINUM ALLOY

N. MURAMATSU, Y.-E. HONG (Yokohama National University, Japan), T. SAKAI (University of Electro-Communications, Tokyo, Japan), and T. ENDO (Yokohama National University, Japan) IN: Recrystallization '90; Proceedings of the 1st International Conference on Recrystallization in Metallic Materials, Wollongong, Australia, Jan. 22-26, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 441-446. Research supported by Light Metals Educational Foundation of Japan. refs

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The factors affecting superplastic elongation in the 7475 Al alloy, when it is processed to the requisite fineness of grain size by thermomechanical working that involves static recrystallization after warm rolling, are presently investigated in as-warm-rolled, unrecrystallized sheets. Experimental results obtained indicate that superplastic elongation is obtainable through the most rapid possible heating of the warm-rolled specimens to the deformation temperature; this temperature is then maintained until just before static recrystallization begins to occur. The equiaxed, fine grains most favorable to plasticity are thereby dynamically generated from pancaked grains. O.C.

A92-26913

THE EFFECT OF RECRYSTALLIZATION ON PRECIPITATION IN SOME AGE-HARDENABLE ALUMINUM ALLOYS

MOTOHIRO KANNO, GOROH ITOH, and BIN-LUNG OU (Tokyo, University, Japan) IN: Recrystallization '90; Proceedings of the 1st International Conference on Recrystallization in Metallic Materials, Wollongong, Australia, Jan. 22-26, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 547-552. Research supported by Light Metals Educational Foundation of Japan. refs

Copyright

Recrystallization which occurs during solution-treatment induces heterogeneous nucleation of incoherent precipitates on Al_3Zr particles during subsequent aging in an Al-Zn-Mg-Cu-Zr and Al-Cu-Mg-Zr alloys. These precipitates never nucleate on coherent Al_3Zr particles in unrecrystallized region. On the other hand, in an Al-Li-Zr alloy, recrystallization brings about the disappearance of duplex precipitates which is composed of Al_3Zr phase situated in the core and delta prime phase in the surroundings. These phenomena can be interpreted in terms of the change in interfacial free energy between a precipitate and Al_3Zr particle. Author

A92-26917

THE EFFECT OF CROSS ROLLING ON ANNEALING TEXTURES OF COLD ROLLED TITANIUM

H. INOUE and N. INAKAZU (Osaka Prefecture, University, Sakai, Japan) IN: Recrystallization '90; Proceedings of the 1st International Conference on Recrystallization in Metallic Materials, Wollongong, Australia, Jan. 22-26, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1990, p. 687-692. refs

Copyright

Orientation distribution function analysis is presently used on specimens annealed in alpha- and beta-phase regions in order to investigate annealing textures for commercially pure Ti sheets that are either straight-rolled or cross-rolled. While the basal plane tilt of the two rolling types differed, the alpha-phase recrystallization textures were rendered similar by annealing at temperatures of the order of 800 C. The annealing textures in beta-phase changed as a function of rolling conditions. The main orientation of the straight-rolled sheet consisted of the same component as the alpha recrystallization textures. O.C.

A92-27224

STRUCTURES AND MECHANICAL PROPERTIES OF AL-FE-ZR ALLOY EXTRUDATES PREPARED BY A RAPID SOLIDIFICATION PROCESSING

YOSHINOBU SAKURAI, YASUHIRO FUKUSHIMA, HIROYASU TEZUKA (Tokyo Institute of Technology, Japan), TAKESHI MURAKAMI (Nishi-Tokyo University, Yamanashi, Japan), and

AKIHIKO KAMIO (Tokyo Institute of Technology, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Dec. 1991, p. 847-852. In Japanese. refs

The relation between microstructures and mechanical properties has been investigated on Al-8 percent Fe-1 to 3 percent Zr alloys produced by the combined rapid solidification and extrusion processing. All extrudates exhibited deformation structures produced during extrusion at 703 K. Dislocation structures were stable even after exposure at 573 K for 100 h. At temperatures higher than 573 K, softening took place in all specimens due both to the recovery of dislocation structures and to the transformation of the metastable Al₆Fe phase to the coarse and stable Al₃Fe phase. Zirconium remained supersaturated in the aluminum matrix even after extrusion. Tensile property of Al-8 percent Fe alloy markedly increased with increasing amount of zirconium up to 623 K. This effect of zirconium was explained by the increased supersaturation of zirconium in the matrix. Author

A92-27376
THE EFFECT OF ADDITIONAL ELEMENT ON THE TENSILE PROPERTIES OF MG-LI BINARY SYSTEM ALLOY

MAKOTO INOUE (Toyama National College of Technology, Japan), KAZUO MATSUZAWA (Tokyo Metropolitan Technical College, Japan), OSAMU TANNO (Toa Steel Co., Ltd., Himeji, Japan), KIYOAKI OHUCHI, and YO KOJIMA (Nagaoka University of Technology, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Feb. 1992, p. 67-73. In Japanese. refs

High-temperature tensile properties of Mg-8 and 13 mass percent Li alloys containing Al, Cu, Zn or Ag have been investigated. Ultimate tensile strength and 0.2 percent proof stress decreased with increase in test temperature. Elongation of Mg-8 percent Li alloy was higher than that of Mg-13 percent Li alloy, while the ternary alloys were more ductile than the binary alloys. Mg-8 percent Li-1 percent Zn alloys annealed at 443 K showed superplastic strain up to about 840 percent at the test temperature of 573 K. Annealing in the recovery temperature range was effective for the development of superplasticity. Author

A92-27377
AGING BEHAVIOR OF AL-4.5 PERCENT MG, AL-4.5 PERCENT MG-0.35 PERCENT MN AND AL-1.3 PERCENT MG-1.1 PERCENT MN ALLOYS CONTAINING 0.2 PERCENT CU

SHINJI TERUTA, MASAFUMI MIZOUCHI (Sky Aluminium Co., Ltd., Fukaya, Japan), and YOTARO MURAKAMI (Osaka Science and Technology Center, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Feb. 1992, p. 78-84. In Japanese. refs

A92-27415
DESIGN OF HIGH ELASTIC MODULUS ALLOY USING FIRST PRINCIPLES ELECTRONIC THEORY

K. MASUDA-JINDO (Tokyo Institute of Technology, Yokohama, Japan) and K. TERAOKURA (Tokyo, University, Japan) IN: Alloy phase stability and design; Proceedings of the Symposium, San Francisco, CA, Apr. 18-20, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 271-276. refs
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The first principles ASW (augmented spherical wave) method is used to predict the elastic properties of Al-base and Ni-base fcc alloys. It is shown that the elastic modulus increase or decrease of the fcc alloys is closely correlated with the change in the lattice constants and that the results for various solute atoms can be summarized in the simple curves, depending on the species of the solute atoms. It is demonstrated that the theoretical calculations for the binary alloys can be used for the design of the (multi-component) fcc alloys with desired elastic properties and lattice constants. Author

A92-27418
DEFORMATION AND DISLOCATION STRUCTURE OF Ti3Al SINGLE CRYSTALS

Y. MINONISHI (Tohoku University, Sendai, Japan) IN: Alloy phase stability and design; Proceedings of the Symposium, San Francisco,

CA, Apr. 18-20, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 301-306. refs

Copyright

Deformation characteristics of Ti₃Al single crystals have been examined as a function of orientation and temperature. This paper mainly describes the result of compression along the c axis. In this orientation, the yield stress increases from 300 to 1100 K, decreasing rapidly thereafter. The anomaly is discussed in comparison with the behavior of other intermetallics and pure metals. Author

A92-27421
MICROSTRUCTURES OF Ni3Al RAPIDLY SOLIDIFIED BY HAMMER-ANVIL TECHNIQUE

YOSHINAO MISHIMA (Tokyo Institute of Technology, Yokohama, Japan), SHIROU SASAKI (Showa Denko, Saitama, Japan), and TOMOO SUZUKI (Tokyo Institute of Technology, Japan) IN: Alloy phase stability and design; Proceedings of the Symposium, San Francisco, CA, Apr. 18-20, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 335-340. refs
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The Hammer-Anvil technique is employed for the rapid solidification of Ni₃Al in the present work. The effect of off-stoichiometry on the change in the microstructure in the quenched alloy is examined for compositions within the Li(2) phase field at equilibrium. It is shown that non-equilibrium phases of various morphologies appear with fine grains of Li(2) phase, which have never been reported for the compound rapidly solidified by the roll techniques. With increasing aluminum concentration and with increase in cooling rate, the latter being judged by the difference in the thickness of the quenched foil, the fraction of the non-equilibrium phases appearing is found to increase giving more complex microstructures. Author

A92-27424
DESIGN OF L1 SUB 2-TYPE Ni3Si INTERMETALLICS

T. TAKASUGI and O. IZUMI (Tohoku University, Sendai, Japan) IN: Alloy phase stability and design; Proceedings of the Symposium, San Francisco, CA, Apr. 18-20, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 363-368. refs
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An Ni₃Si alloy is ductilized by means of stoichiometric control and the addition of titanium, and the mechanical properties and fracture behavior are examined. Attention is given to the improvement of intergranular cohesion by studying the Ni₃Si-Ni₃Ti section by means of optical microscopy, X-ray diffraction, and TEM. Ni₃(Si,Ti) polycrystals are studied with respect to test temperature, doping with other elements, and the environmental effect. In the highly ordered Ni₃(Si,Ti) it is shown that 11 at. pct Ti displaces previously Si locations, and the yield stress is found to increase with Ti content. Ductility in the products varies directly with Ti and Ni content and B and C doping, and vacuum testing greatly increases the values for both ductility and transgranular fracture. It is concluded that B and C atoms compete with hydrogen for site occupation or grain-boundary effectiveness and thereby suppress embrittlement. C.C.S.

A92-28000
ULTRA-FINE EQUIAXED GRAINS OBTAINED BY PROCESS OF HYDROGENATION, AGING AND DEHYDROGENATION IN ALPHA + BETA TYPE TITANIUM ALLOYS

HIROFUMI YOSHIMURA, KIN'ICHI KIMURA, MASAYUKI HAYASHI, MITSUO ISHII (Nippon Steel Corp., Hikari Research and Development Laboratory, Japan), and JIN-ICHI TAKAMURA (Nippon Steel Corp., Tokyo, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, Dec. 1991, p. 1375-1381. In Japanese. refs
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A procedure is described for equiaxed grain refinement in alpha + beta titanium alloys, with particular consideration given to the appearance of two different types of dislocation structures introduced by this procedure. In this procedure, the titanium alloys are hydrogenated with large amounts of hydrogen and

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dehydrogenated in vacuum at elevated temperatures. Of the two types of dislocation structures, one is introduced by the precipitation of hydrides on aging at relatively low temperature after solution treatment of hydrogenated Ti alloys; the other is introduced by martensitic transformation on cooling from the beta-phase or the alpha + beta two-phase region of hydrogenated titanium alloys. The combination of the two factors results in Ti-6Al-4V alloys exhibiting equiaxed grains of about 1-micron diameter. I.S.

A92-28022

EFFECT OF ORDERING ON SUSCEPTIBILITY TO HYDROGEN EMBRITTLEMENT OF A NI-BASE SUPERALLOY

KAORI MIYATA and MASAOKI IGARASHI (Sumitomo Metal Industries, Ltd., Iron and Steel Research Laboratories, Amagasaki, Japan) *Metallurgical Transactions A - Physical Metallurgy and Materials Science* (ISSN 0360-2133), vol. 23A, March 1992, p. 953-961. refs
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Tensile tests in air and with hydrogen-charging in 1N-H₂SO₄ solution are presently used to investigate the effect of ordering on susceptibility to hydrogen embrittlement (SHE) of the C-276 Ni-base superalloy. SHE appears to be reduced by short-term aging, but resumes its increase with further aging. TEM has shown that a short-term ordering reaction from a disordered fcc lattice into an ordered Ni₂(Cr,Mo) superlattice occurs with aging: superdislocation triplets with antiphase boundary therefore become dominant upon deformation. Deformation twinning in aged specimens leads to transgranular fracture at twin boundaries via hydrogen-charging. The results obtained indicate a change in deformation mode after aging which plays a major role in fracture due to SHE as a result of heterogeneous interaction between slip dislocation and twin boundaries. O.C.

A92-28247

OXYGEN SCAVENGING EFFECT OF THE ALPHA-2 PHASE IN THE TIAL INTERMETALLIC COMPOUND

R. UEMORI, T. HANAMURA, and H. MORIKAWA (Nippon Steel Corp., Kawasaki, Japan) *Scripta Metallurgica et Materialia* (ISSN 0956-716X), vol. 26, March 15, 1992, p. 969-974. refs
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The ductility of TiAl can be enhanced by utilizing the lamellar structure of this material; it has been suggested in the past that one of the two mechanisms operating in the enhancement of TiAl ductility is that the alpha-2 phase of the lamellar TiAl structure might enhance ductility by scavenging oxygen from the gamma matrix. In this work, this possibility is investigated experimentally by determining the compositions of alpha-2 and gamma phases of TiAl using an atom-probe field-ion microscope. It is shown that the alpha-2 phase in the lamellar structure of TiAl is much more enriched in oxygen than is the gamma phase, indicating that the alpha-2 phase acts as an oxygen scavenger, decreasing the oxygen content in the gamma phase and improving its ductility. I.S.

A92-28960

SHAPE MEMORY EFFECT OF FE-14 PERCENT MN-6 PERCENT SI-9 PERCENT CR-6 PERCENT NI ALLOY POLYCRYSTALS

HIROSUKE INAGAKI (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan) *Zeitschrift fuer Metallkunde* (ISSN 0044-3093), vol. 83, Feb. 1992, p. 90-96. refs
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The paper examines factors affecting the shape memory effect in FeMnSiCrNi alloy polycrystals. The shape memory effect in this alloy was found to be influenced most by the amount of deformation. With increasing deformation, the shape memory effect diminished appreciably. Although the fraction of the initial dimensional change that could be restored was about 45 percent in the specimen strained by 4 percent, only 21 percent of the initial dimensional change was recovered in the specimen strained by 9 percent. Deformation temperatures were also found to be an important factor that influenced the shape memory effect. The maximum shape memory effect was observed in the specimens strained at temperatures between the Ms and Md temperatures.

The shape memory effect was appreciably intensified by repeated straining and annealing, especially when straining was performed at 500 C. It is suggested that the shape memory effect in Fe-base alloys was strongly influenced by the dislocation substructure present in the starting material. P.D.

A92-28961

TRANSMISSION ELECTRON MICROSCOPY OF THE SHAPE MEMORY PHENOMENA IN FE-14 PERCENT MN-6 PERCENT SI-9 PERCENT CR-6 PERCENT NI ALLOY POLYCRYSTALS

HIROSUKE INAGAKI (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan) *Zeitschrift fuer Metallkunde* (ISSN 0044-3093), vol. 83, Feb. 1992, p. 97-104. refs
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The present study investigates the shape memory effect in FeMnSiCrNi alloy polycrystals systematically and in detail with TEM. In polycrystals, in which many shear systems were inevitably activated simultaneously, the mechanism of the shape memory effect was found to be somewhat different from that proposed in the case of single crystals. During deformation at room temperature highly oriented epsilon martensite plates were formed with two mechanisms, the relative importance of which varied with the level of the applied stress. At a low applied stress level, stacking faults were successively emitted from the same places of grain boundaries or interfaces of preexisting epsilon martensite plates, forming overlapped stacking faults, and resulting finally in the formation of highly oriented epsilon martensite plates. At a higher stress level, at which the density of stacking faults and epsilon martensite plates was significantly increased, frequent interactions among them were the most predominant mechanism of the formation of a new epsilon martensite plate. P.D.

A92-29412

SUPERPLASTIC BEHAVIOUR OF 5083 ALUMINIUM ALLOY BEARING 0.12 WT PCT ZR

HAJIME IWASAKI, YASUYUKI MASAKI (Himeji Institute of Technology, Japan), KENJI HIGASHI, SINJI TANIMURA, TAICHIRO ITO (Osaka Prefecture University, Sakai, Japan), and SATOHIRO HAYAMI (Himeji Institute of Technology, Japan) *Japan Society of Materials Science, Journal* (ISSN 0514-5163), vol. 41, Jan. 1992, p. 17-22. In Japanese. refs
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The superplastic behavior of 5083 + 0.12Zr alloy was investigated in the 783-843 K temperature range and the 8 x 10⁻⁵ to 0.003/s strain rate range at constant strain-rate tensile test. Maximum elongation of 580 percent was obtained at 823 K and at a strain rate of 0.0001/s, with the m value retaining its initial value of 0.5 up to a large strain of 1.3 and where minimum cavitation occurred. The large elongation was due to stable deformation caused by retaining the initial m value up to a large strain. The alloy showed strain hardening induced by dynamic strain growth. The dynamic strain growth rate increased with decreasing strain rate. The decrease of the m value with true strain may have been due to decreasing grain boundary caused by cavitation and grain growth. C.D.

A92-29421

EFFECT OF RARE-EARTH ELEMENTS ON THE STRUCTURES AND MECHANICAL PROPERTIES OF MG-8 PERCENT LI ALLOYS

OSAMU TANNO, KIYOAKI OHUCHI (Nagaoka University of Technology, Japan), KAZUO MATUZAWA (Tokyo Metropolitan Technical College, Japan), SHIGEHARU KAMADO, and YO KOJIMA (Nagaoka University of Technology, Japan) *Japan Institute of Light Metals, Journal* (ISSN 0451-5994), vol. 42, Jan. 1992, p. 3-9. In Japanese. refs

The effect of REE on the structure and mechanical properties of Mg-8 mass pct Li (alpha + beta) alloys has been investigated. REE formed intermetallic compounds with magnesium. Below 90 percent rolling reduction Mg-Li-REE ternary alloys showed work hardening behavior which is similar to that of Mg-Li binary alloy, while above 90 percent rolling reduction they exhibited the work softening probably due to recovery. Isochronal annealing below

373 K softened cold-rolled Mg-Li-RE alloys. On the other hand, the recrystallization temperature was raised by the addition of REE. Age-hardening due to the precipitation of alpha phase in beta phase was observed in all alloys. Overaging was recognized in Mg-Li binary alloy, whereas not in Mg-Li-RE ternary alloys. These results suggest that RE addition improves the thermal stability of precipitates, resulting in the improvement of elevated temperature strength through aging treatment. The addition of REE tended to increase the tensile strength, but to decrease the elongation.

Author

A92-29422

A SMALL PUNCH TEST FOR ALUMINUM, MAGNESIUM, TITANIUM AND SOME OTHER METALS

HAJIME KATO, TATSUMI TOZAWA, and YOSHIMASA TAKAYAMA (Utsunomiya University, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Jan. 1992, p. 10-15. In Japanese. refs

A small punch test has been carried out for the annealed specimens of six kinds of commercially pure metal sheets with 0.5-mm thickness: aluminum, magnesium, titanium, zinc, copper, and iron. A typical punch load versus punch depth curve was indicated for metals except magnesium in which the bulging deformation region was hardly observed in the punch load versus punch depth curve. The magnitude of maximum punch load was in the order of Ti, Fe, Cu, Zn, Al, and Mg, corresponding to the order of tensile strength for each metal except magnesium. The punch depth at maximum punch load in aluminum, titanium, zinc, copper and iron were kept nearly constant independent of the elongation at maximum tensile strength. But the punch depth at maximum punch load was much lower in magnesium than in five other metals. In magnesium the surface cracks formed at a punch depth which is much smaller than that for other metals, resulting in the brittle fracture.

Author

A92-29423

MODEL EXPERIMENTS CONCERNING THE CONTRIBUTION OF HYDROGEN EMBRITTLEMENT ON STRESS CORROSION CRACKING OF HIGH STRENGTH ALUMINUM ALLOY

TADAKAZU OHNISHI (Osaka Prefecture University, Sakai, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Jan. 1992, p. 21-26. In Japanese. refs

Hydrogen embrittlement and SCC behavior of bending 7075-T6 aluminum alloy specimens were examined. The compression side of each specimen with both side notches was only exposed to the cathodic charging solution or SCC environment. The notch strength was gradually decreased with increasing charging time. Prominent embrittlement was found on the tension side, but not on the compression side. Both the embrittlement and cracking on the tension side were also found in a SCC test specimen of which the compression side was only exposed. These results were only caused by the mechanism of hydrogen embrittlement hydrogen-permeated from the compression side and transported to the tension side by diffusion. Thus, it was concluded that the hydrogen embrittlement was involved in the SCC mechanism.

Author

A92-29424

EFFECT OF 15 PERCENT SI ADDITION ON MECHANICAL PROPERTIES OF RAPIDLY SOLIDIFIED AL-FE AND AL-MN ALLOYS

HEE T. SHIN, MAKOTO SUGAMATA, and JUNICHI KANEKO (Nihon University, Narashino, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Jan. 1992, p. 38-44. In Japanese. refs

Rapidly solidified flakes of six alloys systems (Al-Fe, Al-Mn, Al-Si-Fe, Al-Si-Mn, Al-Si-Fe-Mn and AC8A) were produced by using an apparatus combining atomization and water-cooled single copper roll. Consolidation of the flakes was done by cold pressing, degassing, and hot extrusion. Metallography and mechanical properties were studied in order to evaluate the effect of 15 mass pct Si addition on properties of Al-Fe and Al-Mn base rapidly solidified P/M materials. Tensile strength of Al-Fe P/M materials

at room temperature was increased by addition of 15 percent Si, whereas Al-Mn alloys with 15 percent Si addition showed almost same strength as those without 15 percent Si addition. However, elevated temperature tensile strength of the alloys containing 15 percent Si was lower than that of Al-Fe and Al-Mn binary alloys. P/M material of Al-15 percent Si-8 percent Fe alloy showed the highest tensile strength of about 410 MPa at room temperature, and Al-8 percent Fe alloy showed the highest tensile strength of about 140 MPa at 573 K. Ductility of P/M materials was reduced by addition of 15 percent Si.

Author

A92-29425

FATIGUE CRACK GROWTH IN 5083 ALUMINUM ALLOY UNDER VARYING LOADING CONDITIONS

TETSUYA TAKAII and YOSHIHIRO NAKAYAMA (Yamanashi University, Kofu, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, Jan. 1992, p. 45-51. In Japanese. refs

Fatigue crack growth in 5083 aluminum alloy specimen was studied experimentally using compact tension specimens. At a constant load amplitude, log-log plot of crack growth rate (da/dN) vs stress intensity factor range (ΔK_{eff}) becomes linear in the intermediate ΔK range. Fatigue crack growth is retarded by the overloading and the crack growth rate is depressed with increase in the cycle numbers of overloading. Crack growth rate depends on the number of overloading cycle in view of the crack opening ratio. The overloading results in the closure of crack, the area of which increases with increase in the number of overloading cycle.

Author

A92-29498

EFFECT OF HYDROSTATIC PRESSURES ON THERMOELASTIC MARTENSITIC TRANSFORMATIONS IN AGED Ti-NI AND AUSAGED Fe-NI-CO-TI SHAPE MEMORY ALLOYS

TOMOYUKI KAKESHITA, KEN'ICHI SHIMIZU (Osaka University, Ibaraki, Japan), SEI NAKAMICHI (Osaka University, Japan), RITSU TANAKA (NGK Insulators, Ltd., Nagoya, Japan), SHOICHI ENDO (Osaka University, Toyonaka, Japan), and FUMIHISA ONO (Okayama University, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, Jan. 1992, p. 1-6. Research supported by Osaka University and MOESC. refs

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The effect of hydrostatic pressures on thermoelastic martensitic transformations in aged Ti-51 at pct Ni and ausaged Fe-31.9Ni-9.8Co-4.1Ti (at pct) shape memory alloys has been investigated by electrical resistivity measurements under hydrostatic pressures up to 1.5 GPa. The results obtained were as follows: transformation temperatures of the B2 $\rightarrow$ R transformations for two kinds of Ti-Ni alloys aged for short and long periods were independent of pressure. Ms and As temperatures of the successive R $\rightarrow$ B19-prime transformations were linearly increased with increasing pressure for the short aged Ti-Ni alloy, but remained constant for the long aged one. On the other hand, the Ms and Af temperatures in the ausaged Fe-Ni-Co-Ti alloy were inversely decreased with increasing pressure. A thermodynamic analysis on the pressure dependence of the thermodynamic equilibrium temperature, which was obtained from the measured transformation temperatures, showed that the effect of hydrostatic pressures on the B2 $\rightarrow$ R and R $\rightarrow$ B19-prime martensitic transformations in the short aged Ti-Ni alloy was successfully explained by a modified Patel and Cohen's equation, but was not for the gamma - alpha-prime transformation in the ausaged Fe-Ni-Co-Ti alloy.

Author

A92-29500

TRANSIENT LIQUID PHASE BONDING FOR NI-BASE SUPERALLOYS, MAR-M247 AND IN939

MASAKO NAKAHASHI, SEIICHI SUENAGA, MAKOTO SHIROKANE, and HIROMITSU TAKEDA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, Jan. 1992, p. 60-65.

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Transient liquid phase (TLP) bonding combines the ease of manufacture of brazing with the high efficiency of solid-state diffusion bonding. Attention is presently given to the TLP bonding of Ni-base superalloys Mar-M247 and IN939, using rapid solidification-processed flexible foils of suitable filler materials that were selected via metallographic studies. The fillers are shown to produce a bond microstructure virtually identical to that of the base metal. Stress rupture tests are conducted to ascertain the mechanical properties of TLP bonds; sufficient bonding pressures were found to be critically important in Mar-M247's achievement of high bonding efficiency. O.C.

A92-29526

EFFECT OF ALLOY COMPOSITION ON AGE-HARDENING BEHAVIOR OF RAPIDLY SOLIDIFIED AL-MN-CR ALLOYS

HEE T. SHIN, JUNICHI KANEKO, and MAKOTO SUGAMATA (Nihon University, Narashino, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, Jan. 1992, p. 15-22. In Japanese. refs

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Al-Mn-Cr alloys of various compositions were rapidly solidified into solid solutions of extended solid solubilities, and P/M materials were consolidated from rapidly solidified flakes by cold pressing, vacuum degassing, and hot extrusion. Age hardening behavior was examined for both rapidly solidified flakes and P/M materials. Significant age hardening was observed for the alloys containing 10 mass pct of Mn + Cr. However, extruded P/M materials of these alloys showed higher peak hardness than as rapidly solidified flakes. This thermomechanical effect was observed on age hardening of the alloys containing 10 percent of Mn + Cr, whereas no such effect was observed for the alloys containing 7 percent or less of Mn + Cr. Therefore, the optimum Mn and Cr contents for age hardening of rapidly solidified Al-Mn-Cr alloys are such that the G phase, (Mn, Cr)Al₁₂, is the only constituent phase other than alpha-Al, and thus the Al-8Mn-2Cr alloy showed the highest age hardenability. Author

A92-29527

TOUGHNESS AND LAMINATED CRACKING AT LOW TEMPERATURES IN 8090 ALUMINUM ALLOY EXTRUSIONS

SHIGEOKI SAJI, KATUJI FUKUMOTO, MOTOHIRO NAKANO, and KEIZO KISHIDA (Osaka University, Suita, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, Jan. 1992, p. 23-29. In Japanese. refs

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Fracture toughness of L-S and L-T orientation specimens was measured by the three point bend test at 293, 77.4 and 4.2 K, and the tensile properties were tested at various temperatures ranging between 293 K to 6 K for 8090 aluminum alloy extrusions under the peak-aged condition. The interrelationships among the work done for tensile fracture, the uniform elongation, the fracture toughness, and the laminated cracking along grain boundaries at low temperatures are investigated. Results show that the uniform elongation and the work done for fracture increased with decreasing temperature from 293 K to approximately 40 K and decreased slightly under 40 K. The increases in ductility are attributed to the increasing work-hardening ability that is due to the increasing difficulty in cross slip of dislocations with decreasing temperature. R.E.P.

A92-29569

NI-BASE OXIDE DISPERSION STRENGTHENED ALLOYS FOR TURBINE APPLICATIONS

JUN-JI TSUJI, TAKAHITO HOSOKAWA, NORIYASU OGURI, KAZUAKI MINO, and KOICHI ASAKAWA (Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 31, Nov. 1991, p. 447-451. In Japanese. refs

A study has been made on the development of oxide dispersion strengthened (ODS) alloy technologies. An ODS alloy is a hopeful candidate material for turbine components with largely increased inlet temperatures. It is necessary to improve the creep properties at intermediate temperatures as well as high temperatures and

also to develop the forming and manufacturing technologies for the practical use of ODS alloys. Various properties, which are important in selecting as a turbine component material, of ODS alloys newly developed were compared with those of single crystals currently in use. Also described were the developmental studies on isothermal forging treatment for directional recrystallization and diffusion bonding technologies which are necessary to produce complicated air-cooled blade and vane structures. Author

A92-30590

EFFECTS OF ALUMINUM CONTENT AND MICROSTRUCTURE ON FRACTURE TOUGHNESS OF BINARY TiAl ALLOYS

S. TSUYAMA, S. MITAO, and K. MINAKAWA (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan) IN: Microstructure/property relationships in titanium aluminides and alloys; Proceedings of the Symposium, Fall Meeting of the Minerals, Metals, and Materials Society, Detroit, MI, Oct. 7-11, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1991, p. 213-226. refs

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Attention is given to the fracture toughness of binary TiAl alloys with various microstructures examined at room temperature in accordance with ASTM E399. The microstructures were classified into four types which were varied by aluminum content ranging from 44 to 51 at. pct, and by different processing, as-cast, and isothermal forging followed by annealing. The TiAl containing 48-percent Al in as-cast condition corresponding to the third type of microstructure exhibited the highest fracture toughness. This was due to microcrack toughening through microcracking along the interface of alpha-2/gamma lamellae. The equiaxed single phase gamma, which appeared in the first and second microstructures, was cleavage-fractured, and straight grain boundaries corresponding to the last microstructure caused intergranular fracture. The microstructural factors responsible for fracture toughness of TiAl alloys is discussed. C.A.B.

A92-30591

INFLUENCE OF COMPOSITION ON THE GRAIN SIZE DEPENDENCE OF COMPRESSIVE CREEP IN SINGLE-PHASE TiAl INTERMETALLICS

TOHRU TAKAHASHI (Tokyo University of Agriculture and Technology, Koganei, Japan) and HIROSHI OIKAWA (Tohoku University, Sendai, Japan) IN: Microstructure/property relationships in titanium aluminides and alloys; Proceedings of the Symposium, Fall Meeting of the Minerals, Metals, and Materials Society, Detroit, MI, Oct. 7-11, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1991, p. 227-235. Research supported by Shinsei Shigen Kyokai and Light Metal Educational Foundation, Inc. refs

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Constant-stress compressive creep tests were carried out on a polycrystalline Ti-51.5Al intermetallic with the grain diameters in the range of about 22-46 microns at 1100 K in the stress range of about 100-316 MPa in an argon atmosphere. The creep rate decreased with increasing grain diameter, particularly at low stresses. These results are combined with those found previously for materials of near- and off-stoichiometric compositions. The grain size affects the creep rate of single-phase TiAl most significantly at low applied stresses and at low aluminum concentrations.

Author

A92-30593

SUPERPLASTICITY OF THERMOMECHANICALLY PROCESSED GAMMA TITANIUM-ALUMINIDES

KEIZO HASHIMOTO, NAOYA MASAHASHI, YUJI MIZUHARA (Nippon Steel Corp., Research and Development Laboratories-I, Kawasaki, Japan), HIDEKI FUJII (Nippon Steel Corp., Research and Development Laboratories-II, Sagami, Japan), and MUNETSUGU MATSUO (Nippon Steel Corp., Research and Development Laboratories-I, Kawasaki, Japan) IN: Microstructure/property relationships in titanium aluminides and alloys; Proceedings of the Symposium, Fall Meeting of the Minerals,

Metals, and Materials Society, Detroit, MI, Oct. 7-11, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1991, p. 253-262. refs
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Superplastic forming and diffusion bonding are a key technology for application of gamma titanium as potential structural materials in hypersonic aircraft. Grain refinement is the primary requisite for superplasticity. Thermomechanical processing has been developed and applied to ternary alloyed gamma titanium aluminides for microstructure control. The fine-grained microduplex materials can be deformed superplastically more than 400 percent in tensile testing at 1473 K. Microstructural aspects of the superplastic behavior have been characterized in term of the morphology of two phases in a gamma titanium aluminide based alloy. Author

A92-30597
EFFECT OF ALUMINUM CONTENT ON CREEP DEFORMATION BEHAVIOR OF GAMMA-TITANIUM ALUMINIDES

S. MITAO, S. TSUYAMA, and K. MINAKAWA (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan) IN: Microstructure/property relationships in titanium aluminides and alloys; Proceedings of the Symposium, Fall Meeting of the Minerals, Metals, and Materials Society, Detroit, MI, Oct. 7-11, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1991, p. 297-311. refs
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The effect of aluminum content on creep deformation behavior of gamma-titanium aluminides was studied. As-cast binary titanium aluminides containing different levels of aluminum ranging from 44 to 51 at percent were prepared and creep rupture tests were carried out at 1073 K and 1223 K. It was found that the best creep resistance was obtained at about 48 at. percent Al under each test condition, although the bulk strength increased with decreasing aluminum content. Furthermore, it was revealed that microstructural characteristics of alloys such as Ti3Al (α_2)/TiAl(γ) lamellar structure and morphology of lamellar grain boundary, were also influenced by aluminum content. The creep property of gamma-titanium aluminides with different aluminum levels is discussed in terms of creep deformation processes. Author

A92-30599
TEXTURE AND MICROSTRUCTURE IN CONTINUOUSLY CAST GAMMA TITANIUM-ALUMINIDE SHEETS

MUNETSUGU MATSUO, TOSHIHIRO HANAMURA, MASAO KIMURA, NAOYA MASAHASHI, and TOSHIKI MIZOGUCHI (Nippon Steel Corp., Research and Development Laboratories, Kawasaki, Japan) IN: Microstructure/property relationships in titanium aluminides and alloys; Proceedings of the Symposium, Fall Meeting of the Minerals, Metals, and Materials Society, Detroit, MI, Oct. 7-11, 1990. Warrendale, PA, Minerals, Metals, and Materials Society, 1991, p. 323-335. refs
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Twin roll casting is applied to the production of gamma titanium aluminide sheets. Flat sheets of 100-mm width were continuously cast with a uniform thickness in the range of 1 to 2 mm. Microstructures in the direct cast sheets were characterized to elucidate the history of microstructure evolution in direct casting. The continuous casting process evolves the microstructure that is characterized by a sharp preferred orientation and fine lamellar structure in the subsurface zone of as-cast sheets. The preferred orientation develops with the 111 line axis parallel to the normal direction of the sheets. Lamellae of (γ + α_2) are extensively refined in rapid cooling. Through-the-thickness microstructures are characterized by a curvature of the growth direction of columnar grains along the thermal gradient, an increase in the fraction of the gamma grains toward the center, accommodation of the thermal stress in gamma grains, and the occasional appearance of shrinkage cavities in the center.

C.A.B.

A92-30737
DEFORMATION MICROSTRUCTURES IN B2-TYPE COTi SINGLE CRYSTALS

M. YOSHIDA (Miyagi National College of Technology, Natori, Japan) and T. TAKASUGI (Tohoku University, Sendai, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 273-278. refs
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A deformation-microstructure investigation has been conducted on B2-type CoTi single crystals exhibiting the yield-strength anomaly at various temperatures and compression axes, using TEM to ascertain the morphological features and Burgers vectors of the activated dislocations. While relatively straight dislocations of the 001-type Burgers vector were observed at 300 K, at 773 K (where yield stress increases with temperature) the screw components of dislocations were dominant and exhibited a morphology indicative of pinning or cross slip. At 973 K, the activated dislocation Burgers vectors were of 001 type for compressive orientation axes close to -1 1 1 and 0 1 1; a 110-type orientation axis was found close to 0 0 1. O.C.

A92-30738
A MECHANISM OF THE POSITIVE TEMPERATURE DEPENDENCE OF YIELD STRESS IN TiAl

T. KAWABATA (Sumitomo Light Metal Industries, Ltd., Technical Research Laboratories, Nagoya, Japan), T. KANAI (Hitachi, Ltd., Hitachi Research Laboratory, Japan), and O. IZUMI (Tohoku University, Sendai, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 279-284. refs
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The positive temperature dependence of yield stress (PTYS) has been observed (Kawabata et al., 1985) in TiAl single crystals in all orientations operating ordinary dislocations with the Burgers vector $1/2$ mixed 110 and superdislocations with the Burgers vectors mixed 101 and $1/2$ mixed 112. A mechanism for the PTYS is proposed, which is a cross-slip and pinning mechanism of Shockley partials with the Burgers vector $1/6$ mixed 112 or/and $1/6$ mixed 121. The results of strain rate dependence of yield stress, K value dependence of critical resolved shear stress (CRSS) and transmission electron microscopy support the theory. Here, K value is the Schmid factor ratio of a Shockley partial on mixed 101 or mixed 110 plane and a perfect ordinary dislocation or a perfect superdislocation on mixed 111 plane. Author

A92-30756
EFFECTS OF ALLOYING ADDITIONS ON INTERGRANULAR FRACTURE OF ORDERED INTERMETALLICS

TAKAYUKI TAKASUGI (Tohoku University, Sendai, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 403-416. refs
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This article summarizes recent studies on the intergranular brittle fracture from the point of view of compositional and resultant structural (and electrochemical) properties of grain boundaries. Significant improvement in ductility is established by the control of chemical composition, that is, by the selection of constituent elements, the control of alloy stoichiometry, the addition of substitutional elements, the change of degree of ordering, and doping by the interstitial elements. Also, the gaseous atoms hydrogen and oxygen from environment or as residue are shown to strongly affect the grain-boundary fracture behavior. Emphasis is placed on the L1(2)-type ordered intermetallics including Ni3Al, Ni3Si and Co3Ti. Author

A92-30776
DUCTILITY AND STRENGTH IN MO MODIFIED TiAl

T. MAEDA, M. OKADA, and Y. SHIDA (Sumitomo Metal Industries, Ltd., Advanced Technology Research Laboratories, Amagasaki, Japan) IN: High-temperature ordered intermetallic alloys IV;

26 METALLIC MATERIALS

Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 555-560. refs
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A92-30778

DEFORMATION OF POLYSYNTHETICALLY TWINNED (PST) CRYSTALS OF TiAl IN TENSION AND COMPRESSION AT ROOM TEMPERATURE

H. INUI, A. NAKAMURA, and M. YAMAGUCHI (Kyoto University, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 569-574. Research supported by MOESC and Iketani Science and Technology Foundation. refs
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A92-30785

EFFECT OF OFF-STOICHIOMETRY ON THE CREEP BEHAVIOR OF BINARY AND TERNARY Ni3Al

TOHRU HAYASHI (Tokyo Institute of Technology, Yokohama, Japan), TETSUMORI SHINODA (Hitachi, Ltd., Hitachi Research Laboratory, Japan), YOSHINO MISHIMA (Tokyo Institute of Technology, Yokohama, Japan), and TOMOO SUZUKI (Tokyo Institute of Technology, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 617-622. refs
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A92-30786

THE COMPRESSION CREEP BEHAVIOR OF Ni3Al-X SINGLE CRYSTALS

SEIJI MIURA, TOHRU HAYASHI, MITSUHIRO TAKEKAWA, YOSHINO MISHIMA (Tokyo Institute of Technology, Yokohama, Japan), and TOMOO SUZUKI (Tokyo Institute of Technology, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 623-628. refs
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The high-temperature creep deformation behavior of Ni3Al + X single crystals (containing, in at. pct, 5 Ti, 2.5 Si, 2 Hf, and 4 Cr), with near 001 stress axis, was investigated, and results were compared with those of high-temperature compression tests under a constant strain rates between $10 \exp -8/\text{sec}$ and $10 \exp -6/\text{sec}$, for the same crystallographic orientation. It was found that the deformation mechanism (namely, octahedral viscous flow), for the two cases was identical and that both deformations could be expressed by a state equation of the power-law type with a stress exponent equal to 3 to 4. Also examined was the effect of off-stoichiometry on the creep resistance in Ni3(Al-5 at. pct Ti) alloys with different Ni concentrations. It was found that the magnitude of the creep resistance of Ni3(Al,5Ti) alloys increased with increasing Ni concentration on both sides of stoichiometry, exhibiting a discontinuity at stoichiometry. I.S.

A92-30801

STRUCTURE DEPENDENCE OF TENSILE CREEP BEHAVIOR IN THERMO-MECHANICALLY-TREATED Ti-50 MOL PCT AL INTERMETALLICS

TOHRU TAKAHASHI (Tokyo University of Agriculture and Technology, Koganei, Japan) and HIROSHI OIKAWA (Tohoku University, Sendai, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 721-726. Research supported by Shinsei Shigen Kyokai and Light Metal Educational Foundation, Inc. refs (Contract MOESC-63550522)
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Tensile creep properties have been studied in Ti-50 mol pct Al intermetallics prepared by ingot metallurgy. Four types of structure were obtained in as-cast material (C), homogenized material (CA),

isothermally forged material (F), and forged-and-recrystallized material (FA). Structural effects was investigated by comparing creep properties such as minimum creep rates, fracture strains, and creep life among C, CA, F, and FA materials. Creep characteristics were strongly dependent upon the structure.

Author

A92-30811

TERNARY ALLOYING OF GAMMA TITANIUM-ALUMINIDES FOR HOT-WORKABILITY

NAOYA MASAHASHI, Y. MIZUHARA, M. MATSUO, K. HASHIMOTO, M. KIMURA, T. HANAMURA, and H. FUJII (Nippon Steel Corp., Research and Development Laboratories, Kawasaki, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 795-800. refs
Copyright

A microstructurally controlled gamma(TiAl)-based alloy containing beta(bcc) has shown remarkable tensile properties at high temperatures. It exhibits over 450 percent tensile elongation at 1473 K. The strain rate sensitivity factors are calculated to be over 0.3 above 1273 K. A specific texture is not observed from transmission X-ray photograph. TEM observation reveals that the precipitated beta phase located at grain boundaries elongates uniformly along gamma grain boundaries and causes large ductility. Beta/gamma dual phase alloys are proposed as high temperature deformable materials.

Author

A92-30821

MICROSTRUCTURE OF RAPIDLY SOLIDIFIED Nb3Al-X RIBBONS

KEN YASUDA, TETSUO FUJIWARA, HIDEYO KODAMA, and MASATERU SUWA (Hitachi, Ltd., Hitachi Research Laboratory, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 865-870. refs
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Nb-Al and Nb-Al-X (X = Cr, Ti, or Zr) alloys with composition approximating the Nb3Al structure have been rapidly solidified by arc-melt-spinning into ribbons. An investigation is conducted of the relationship of the phases of these Nb3Al rapid solidification-structure alloys and their compositions. Homogeneity of structure is found to be difficult to achieve in virtue of the high flow viscosity of the spun melt, as well as the complexity of the Nb-Al phase diagram. Cr and Ti are located at Nb atom sites, and Zr appears to be located at Al atom sites in both Nb3Al and sigma phases. While ribbons of Nb bcc single phase are ductile, those of Nb3Al and/or sigma are very brittle. O.C.

A92-30822

COLD-ROLLING AND SUBSEQUENT ANNEALING OF Ti-RICH TiAl POLYSYNTHETICALLY TWINNED (PST) CRYSTALS

M. H. OH, H. INUI, S. R. NISHITANI, and M. YAMAGUCHI (Kyoto University, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 871-876. Research supported by MOESC and Iketani Science Technology Foundation. refs
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A92-30837

DEVELOPMENT OF SURFACE TREATMENT TECHNIQUES TO IMPROVE OXIDATION RESISTANCE OF TITANIUM ALUMINIDE

MICHIKO YOSHIHARA, RYOHEI TANAKA, TETUYA SUZUKI, and MASAYUKI SHIMIZU (Yokohama National University, Japan) IN: High-temperature ordered intermetallic alloys IV; Proceedings of the 4th MRS Symposium, Boston, MA, Nov. 27-30, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 975-980. refs
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A92-31440

FORMATION OF AMORPHOUS ALUMINUM TANTALUM NITRIDE POWDERS BY MECHANICAL ALLOYING

M. S. EL-ESKANDARANY, K. AOKI, and K. SUZUKI (Tohoku University, Sendai, Japan) *Applied Physics Letters* (ISSN 0003-6951), vol. 60, March 30, 1992, p. 1562, 1563. refs (Contract MOESC-03302053)

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Aluminum tantalum nitride amorphous alloy powders have been synthesized by a high energy ball mill under purified nitrogen gas flow at room temperature. The alloy powders were characterized by means of transmission electron microscopy, differential thermal analysis, and chemical analysis. An amorphous phase containing 18 at. pct N₂ was obtained after 65 ks of the milling time. At the final stage of milling (72 ks) the crystallization temperature and enthalpy change of crystallization are 1115 K and -95 kJ/mol, respectively. Author

A92-32021

FATIGUE PROPERTY OF NITRIDED Ti-6Al-4V ALLOY

TATSURO MORITA, MASAO SHIMIZU, KAZUHIRO KAWASAKI, and TAKAYO CHIBA (Japan Society of Mechanical Engineers, Transactions A (ISSN 0387-5008), vol. 56, Sept. 1990, p. 1915-1919. In Japanese. refs

An attempt was made to clarify the detrimental effect of nitriding on the fatigue strength of titanium alloy through some critical experiments concerning the fatigue properties of gas-nitrided Ti-6Al-4V alloy including the material with a small artificial surface pit. The results of the plane bending fatigue test showed that the fatigue strength of Ti-6Al-4V alloy is reduced greatly due to nitriding. Fractography of the fracture surface revealed that the existence of a nitrided layer at the surface affects the behavior of a fatigue crack in an early growth stage. All parts of the nitrided layer affect the reduction of fatigue strength. A small pit (d = 82 microns) has little effect on reducing the fatigue strength of nitrided alloy while such a pit gives a large reduction of the fatigue strength of unnitrided alloy. Author

A92-32390

IMPROVEMENTS OF SCALE ADHERENCE ON HEAT-RESISTING ALLOYS AND COATINGS BY RARE EARTH ADDITIONS

YASUTOSHI SAITO and BULENT ONAY (Tokyo Institute of Technology, Yokohama, Japan) IN: *Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films*, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 336-346. refs

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Several of the mechanisms proposed to explain the 'rare earth effect' in the prevention of the spallation of corrosion-resistant Cr₂O₃ and Al₂O₃ scales are discussed. It is shown that, depending on the alloy composition, the rare earths improve scale adherence by several different mechanisms. These include the elimination of void formation at the alloy-scale interface and decreasing the scale thickness of Cr₂O₃ scales, and the changes in scale microstructure and morphology for Al₂O₃ scales. Development of an irregular alloy-scale interface and the obtaining of the indigenous alloy impurities by the rare earth additions are also important for the adherence of both types of scales. A uniform distribution of the oxide dispersion in or over the alloy is shown to be an important factor which affects their effectiveness. P.D.

A92-32396

MODELLING OF RESIDUAL STRESS IN PLASMA-SPRAYED COATINGS - EFFECT OF SUBSTRATE TEMPERATURE

S. TAKEUCHI, M. ITO, and K. TAKEDA (Nippon Steel Corp., Research and Development Laboratories I, Kawasaki, Japan) IN: *Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films*, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science,

1990, p. 426-435. refs

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A model including both primary and secondary cooling was developed to predict the effect of the substrate temperature on residual stress. When the expansion coefficient of the coating is less than that of the substrate, the model predicts that a high substrate temperature induces compressive stress and that a low substrate temperature generates tensile stress. Therefore an optimum substrate temperature exists to minimize residual stress. P.D.

A92-32479

THERMOELASTIC MARTENSITE AND SHAPE MEMORY EFFECT IN B2 BASE NI-AL-FE ALLOY WITH ENHANCED DUCTILITY

R. KAINUMA, K. ISHIDA, and T. NISHIZAWA (Tohoku University, Sendai, Japan) *Metallurgical Transactions A - Physical Metallurgy and Materials Science* (ISSN 0360-2133), vol. 23A, April 1992, p. 1147-1153. Research supported by MOESC and Miyashita Research Foundation for Materials Science. refs

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A ductile shape memory alloy of the Ni-Al-Fe system is developed using principles through the control of microstructure. Addition of Fe to the binary Ni-Al shape memory alloy allows the introduction of a ductile face-centered cubic (fcc) phase in an otherwise extremely brittle beta-phase alloy, leading to an improvement in its ductility while retaining its ability to exhibit shape memory arising from the martensitic transformation of the beta phase to L1(0) structure. The transformation temperature in the ternary Ni-Al-Fe alloy can be easily controlled by the preannealing in the beta + gamma region. Experimental results on the effect of different annealing treatments on the microstructures and the shape memory behavior in this alloy are presented and discussed. Author

A92-33490

THERMALLY ASSISTED SOLID STATE AMORPHIZATION OF ROD MILLED AL50NB50 ALLOY

M. SHERIF EL-ESKANDARANY, KIYOSHI AOKI, and KENJI SUZUKI (Tohoku University, Sendai, Japan) *Journal of Applied Physics* (ISSN 0021-8979), vol. 71, March 15, 1992, p. 2924-2930. refs

(Contract MOESC-03555139; MOESC-03302053)

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The amorphization and crystallization of mechanically alloyed Al₅₀Nb₅₀ powder prepared by the rod-milling technique are studied. The amorphization takes place in three distinct stages. The end product of each stage varies widely among stage to stage in structure, morphology, and thermal properties. At the amorphization stage of mechanical alloying (MA), heating the alloy powders to 800 K leads to the formation of an amorphous phase by solid-state diffusion. The enthalpy stage of amorphization of 86 ks alloy powders is found to be -1.80 kJ/mol. The amorphization temperature and the activation energy of amorphization are independent of the MA time and have almost the same values of 650 K and 170 kJ/mol, respectively. The crystallization temperature and the enthalpy change of crystallization of amorphous Al₅₀Nb₅₀ alloy milled for 1440 ks are 1105 K and -13 kJ/mol, respectively. C.D.

A92-33871

LAMELLAR ORIENTATION DEPENDENT ANISOTROPY OF FRACTURE TOUGHNESS IN GAMMA-BASE TITANIUM ALUMINIDE

S. MITAO, T. ISAWA, and S. TSUYAMA (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan) *Scripta Metallurgica et Materialia* (ISSN 0956-716X), vol. 26, May 1, 1992, p. 1405-1410. refs

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The effect of lamellar orientation on the fracture toughness of a gamma-base titanium aluminide (Ti-47.2 percent Al) alloy was investigated. Results of standard fracture toughness tests and SEM observations showed that fracture toughness on the plane parallel

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to alpha-2/gamma lamellae was low (at about 10 MPa sq rt m), while that on the plane perpendicular to the lamellae was at around 35 MPa sq rt m. Fracture on the plane parallel to the lamellae is considered to be due to interlamellar separation. I.S.

A92-35916

RESEARCH AND DEVELOPMENT OF AIRCRAFT ENGINE MATERIALS

JUMPEI SHIOIRI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 459, 1992, p. 214-219. In Japanese. refs

The development of heat-resistant alloys for turbine blades is presented. The preparation of superalloys using the rapid solidification rate method is studied. The prealloyed powder metallurgy method is presented for turbine disk materials. Y.P.Q.

A92-36911

ELASTIC ANISOTROPY OF DIRECTIONALLY SOLIDIFIED SUPERALLOY

TADASHI HASEBE (Kyoto University, Japan), MASAO SAKANE, and MASATERU OHNAMI (Ritsumeikan University, Kyoto, Japan) ASME, Transactions, Journal of Engineering Materials and Technology (ISSN 0094-4289), vol. 114, no. 2, April 1992, p. 141-146. refs

(Contract MOESC-B-63460074)

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The elastic compliance matrix and Young's modulus of directionally solidified superalloy plates composed of five columnar grains are presently described in view of 3D FEM analyses that took into account crystal anisotropy. The calculated elastic compliance matrix was reduced to an orthotropic matrix after yielding a suitable rotation of coordinates, and compared with the results of Reuss and Voigt (1929); the latter are judged to be the more accurate. Attention is given to the Young's modulus in any direction in the cases of both coaxial and noncoaxial models. O.C.

A92-36914

HIGH TEMPERATURE LOW CYCLE FATIGUE AND CYCLIC CONSTITUTIVE RELATION OF MAR-M247 DIRECTIONALLY SOLIDIFIED SUPERALLOY

TADASHI HASEBE (Kyoto University, Japan), MASAO SAKANE, and MASATERU OHNAMI (Ritsumeikan University, Kyoto, Japan) ASME, Transactions, Journal of Engineering Materials and Technology (ISSN 0094-4289), vol. 114, no. 2, April 1992, p. 162-167. refs

(Contract MOESC-B-63460074)

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This paper investigates the effect of solidification direction on cyclic constitutive relation and low cycle fatigue life for a directionally solidified (DS) superalloy Mar-M247LC at 1173 K in air. Strain controlled push-pull low cycle fatigue tests were carried out for three kinds of specimens of which loading direction was 0, 45 and 90 deg to DS axis. The 0 deg specimen exhibited the largest fatigue strength, the 45 deg specimen the smallest and the 90 deg specimen the intermediate. The difference in the fatigue strength due to the loading direction was discussed in detail from the viewpoint of the anisotropy of Young's modulus. A life prediction method for DS specimens, considering the anisotropy of the Young's modulus, was proposed and successfully applied to the low cycle fatigue data. Author

A92-37024

TRANSFORMATION TEXTURES IN Ti-15V-3Cr-3Sn-3Al ALLOY SHEETS

HIROFUMI INOUE (Osaka Prefecture, University, Sakai, Japan), SHINJI FUKUSHIMA (Osaka Prefecture, University, Sakai; Kwansei-Gakuin Senior High School, Nishinomiya, Japan), and NAOTSUGU INAKAZU (Osaka Prefecture, University, Sakai, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 2, Feb. 1992, p. 129-137. refs

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The transformation textures of the alpha phase precipitated by

aging in Ti-15V-3Cr-3Sn-3Al alloy sheets with cold rolling or recrystallization textures in the beta parent phase were investigated experimentally and compared quantitatively with textures predicted theoretically using crystallite orientation distribution functions. The principal types of the transformation textures are identified, and the mechanisms of their formation are discussed. V.L.

A92-37025

AMORPHOUS (Zr-Y)60Al15Ni25 ALLOYS WITH TWO SUPERCOOLED LIQUID REGIONS

TAO ZHANG, AKIHISA INOUE, SUJUN CHEN, and TSUYOSHI MASUMOTO (Tohoku University, Sendai, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 2, Feb. 1992, p. 143-145. refs

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An amorphous phase exhibiting two distinguishable supercooled liquid regions was found in quaternary (Zr-Y)60Al15Ni25 alloys in which the main constituent elements of Zr and Y are immiscible in a solid state. The first- and second-stage supercooled liquid regions are observed in the temperature ranges of 640 to 664 K and 763 to 810 K, respectively, accompanied by the two-distinguishable exothermic peaks due to crystallization after the appearance of the supercooled liquid regions. The temperatures of the first- and the second-reactions appear to correspond to those for ternary Y60Al15Ni25 and Zr60Al15Ni25 amorphous alloys, respectively. The simultaneous dissolution of the immiscible Zr and Y elements is essential for the appearance of the two-stage supercooled liquid regions. From the appearance of the second-stage supercooled liquid region, it is concluded that the precipitation of the primary crystalline phase does not exert deleterious influence on the appearance of the supercooled liquid region. Author

A92-37809

MICROSTRUCTURAL CHANGE DURING SUPERPLASTIC DEFORMATION OF THE MG-8 MASS PCT LI ALLOY

WATARU FUJITANI, NORIO FURUSHIRO (Osaka University, Suita, Japan), SHIGENORI HORI (Teikyo University, Utsunomiya, Japan), and KANJI KUMEYAMA (NTN Co., Ltd., Iwata, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 3, March 1992, p. 125-131. In Japanese. refs

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Microstructural changes during superplastic deformation at 573 K have been investigated of an Mg-8 mass pct Li eutectic alloy under both cast and thermomechanically processed conditions. The elongation of about 300 pct is obtained for as-cast specimen under the superplastic condition, which is increased by finer grain-structure developed by more rapid solidification. Needlelike alpha phase is observed to change to an equiaxed shape during superplastic deformation, and the *m* value of 0.2 at the initial period correspondingly increases during the deformation. In the specimen of the recrystallized structure, twinning is observed in the alpha phase at the initial stage of superplastic deformation. The alpha grains are found to grow during the deformation, while the refining of beta grains takes place. As a result, the mean grain size is slightly increased during deformation. These microstructural changes will play an important role to exhibit superplasticity. Author

A92-38394

EVALUATION OF THE PHASE STABILITY OF MODIFIED IN738LC ALLOYS WITH NEW PHACOMP

J. S. ZHANG, K. MATSUGI, Y. MURATA, M. MORINAGA, and N. YUKAWA (Toyoashi University of Technology, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, no. 8, April 15, 1992, p. 446-448. refs

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Alloy compositions suitable for hot corrosion-resistant single-crystal superalloys for long-term, high-performance marine and industrial gas turbine service are presently defined by means of the new phase computation ('New Phacomp'). The New Phacomp alloy-design concept is based on DV-X sub alpha cluster calculations of the electronic structure of transition metals, in which

the d-orbital energy level and bond order of alloying transition metals are used as the parameters controlling phase stability. Attention is given to the evaluation results obtained for IN738LC. O.C.

A92-39846
FATIGUE CRACK GROWTH AT MODERATELY ELEVATED TEMPERATURES

KEIJI OGURA, IZURU NISHIKAWA, and YOSHIO MIYOSHI (Osaka University, Toyonaka, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 83-104. refs Copyright

Experimental results on fatigue crack growth and crack closure at moderately elevated temperatures are presented for a low carbon steel, Cr-Mo-V steel, type 304 stainless steel and A2218-T6 aluminum alloy. The role of crack closure in the temperature dependence of fatigue threshold is discussed. Special attention is paid to the effect of oxide products on crack closure at elevated temperatures. Experimental results and a discussion are also included on the growth of small cracks at the notch root. Author

A92-39926
BENDING STRENGTH OF HYDROGEN-CHARGED Ti-13V-11CR-3AL ALLOY

KEIJIRO NAKASA and JIANPING LIU (Hiroshima University, Higashi-Hiroshima, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, no. 9, Sept. 1991, p. 922-927. In Japanese. refs Copyright

Bending tests were carried out on a Ti-13V-11Cr-3Al alloy which was charged with hydrogen by an electrolytic method and a high-temperature high-pressure H₂ gas method. Bending strengths sigma(b) of as-solution treated specimens as well as aged specimens decreased with increase in electrolytic hydrogen charging time. The decrease in sigma(b) was small when the charging current density i(c) was 500 A/sq m, while it was large when i(c) were 1000 A/sq m and 3000 A/sq m. The bending strength of the specimens charged with hydrogen at high temperatures and high pressures decreased with increase in hydrogen concentration in specimens. X-ray diffraction analysis of the fracture surface showed that the decrease in sigma(b) by the hydrogen charging was caused by a decrease in cleavage strength of the (100) plane due to the resolution of hydrogen atoms into metal. Author

A92-39929
FRACTURE CHARACTERISTICS OF TITANIUM-BASED INTERMETALLIC COMPOUND Ti3Al

MITSUO NIINOMI, TOSHIRO KOBAYASHI, KAZUNORI RYUGOH (Toyoashi University of Technology, Japan), J. C. WILLIAMS (GE Aircraft Engines, Cincinnati, OH), W. M. GARRISON, JR., and A. W. THOMPSON (Carnegie Mellon University, Pittsburgh, PA) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 55, no. 9, Sept. 1991, p. 1023-1030. In Japanese. refs Copyright

Accurate fracture toughness test methods on the titanium-based intermetallic compound Ti₃Al, with Nb addition, was examined using three-point bending specimens. The microfracture mechanism was also studied. Load-deflection curves indicate elastic-plastic behavior in both the static and dynamic fracture toughness tests. Crack-initiation points were evaluated by acoustic emission, the compliance change rate method, and the multiple specimen method. Under static conditions, there was good agreement among these methods. Fracture toughness values obtained using notched specimens with various root radii were in good agreement with those obtained using fatigue-precracked specimens tested under both static and dynamic conditions. Microcracks, debonding of the alpha₂(Ti₃Al)-beta₀(Ti₂NbAl) interface, planar slip bands, and a planar dislocation structure were observed near the crack tip. The planar dislocation structure in the alpha₂ phase had a tendency of concentrating near the alpha₂-beta₀ interface under dynamic conditions. S.A.V.

A92-40524
SIMULATION OF SOLIDIFICATION AND VISCOPLASTIC STRESSES DURING VERTICAL SEMICONTINUOUS DIRECT CHILL CASTING OF ALUMINUM ALLOY

T. INOUE and D. Y. JU (Kyoto University, Japan) International Journal of Plasticity (ISSN 0749-6419), vol. 8, no. 2, 1992, p. 161-183. refs

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A method to simulate temperature and stress fields in solidifying cylindrical ingots during the vertical semicontinuous direct chill casting process is presented in this paper. As the first approximation of the whole process, a steady state in the casting ingot with enough length is examined, and the steady heat conduction equation with heat generation due to solidification incorporated with material flow is solved by the finite element method. Based on the obtained temperature distribution, elastic-viscoplastic stresses were also calculated to obtain residual stresses. Here, material parameters appearing in the constitutive equation were determined by the data of tensile stress-strain curves under some strain rates at several temperature levels close to the melting temperature. Calculated temperature and residual stress fields were compared with the experimental data to verify the analytical procedure, and discussions are also given on the effect of operating conditions on the fields. Author

A92-40531
SITE SUBSTITUTION OF ADDITIVE ELEMENTS IN TIAL INTERMETALLIC COMPOUND

HARUO DOI, KENKI HASHIMOTO, KAZUO KASAHARA, and TOKUZOU TSUJIMOTO (National Research Institute for Metals, Tokyo, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 3, March 1992, p. 232-237. In Japanese. refs

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Site occupation ratios of third-element additions (Fe, Ni, Cu, Ag, Pt, Ga, and Sb) to the L1(0)-type compound TiAl are determined by using X-ray diffraction. The results show that Fe and Ag atoms predominantly occupy the Al site, whereas Cu and Sb atoms occupy the Ti site, and Ni, Pt, and Ga atoms occupy both sites; the amount of mutual exchanges of Al and Ti atoms in the lattice sites increases with the addition of Cu, Ag, Pt, Ga, and Sb into the Al-rich TiAl phase, whereas it does not change with the addition of Fe and Ni into the Ti-rich TiAl phase. S.A.V.

A92-40532
MOBILITY OF EDGE DISLOCATIONS IN AL-MG SOLUTION HARDENED ALLOYS AT HIGH TEMPERATURES

HIDEHARU NAKASHIMA and HIDEO YOSHINAGA (Kyushu University, Kasuga, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 3, March 1992, p. 254-261. In Japanese. refs

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Dislocation densities are obtained for the high-temperature deformation of Al-Mg alloys by the stress change and stress relaxation tests using the theoretical edge dislocation-mobility of Cottrell (1953). The dislocation densities are about ten times as large as the densities measured by transmission electron microscopy. The mobility of edge dislocations is re-evaluated by assuming that the interaction energy between edge dislocation and solute atom decreases with an increase in solute concentration. S.A.V.

A92-40536
FRACTURE TOUGHNESS OF TIAL INTERMETALLIC COMPOUND PREPARED BY REACTIVE-SINTERING

HIDEO MIZUKOSHI and KAZUHISA SHIBUE (Sumitomo Light Metal Industries, Technical Research Laboratories, Nagoya, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 3, March 1992, p. 342-346. In Japanese. refs

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The fracture toughness and fatigue crack growth rate of Ti-33.5 mass pct Al-2.5 mass pct Mn made by a reactive-sintering process have been evaluated by the ASTM E-399 and E-647 test methods.

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The results show that the fatigue crack growth rate increases with increasing stress ratio, and that the fracture toughness of reactive-sintered TiAl at room temperature is 14 MPa x m to the 1/2, which is greater than that of arc-melted TiAl, due to the fact that the grain size of reactive-sintered specimens is finer and more uniform than that of arc-melted specimens. S.A.V.

A92-41104

CHARACTERIZATION OF THE TRANSFORMATION IN NITI PHASE BY DIFFERENTIATING DIFFERENTIAL SCANNING CALORIMETRY THERMOGRAM

H. MATSUMOTO (National Defense Academy, Yokosuka, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, no. 9, May 1, 1992, p. 588, 589. refs

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NiTi alloys are presently studied by means of DSC in order to reveal the characteristic behavior of the phase-change transformation. It is emphasized that the precise thermal analysis obtained by differentiating the thermogram in DSC is helpful in detecting the transition to an intermediate phase, if the latent heat of the transformation is small; it is also useful in characterizing the transformation behavior with the line shape of the thermogram in DSC. Traces of the transition to the intermediate phase are detectable for NiTi-1 at. pct Si despite the overlapped transformations and very small latent heat of the transition to the intermediate phase. O.C.

A92-41839

DETERMINATION OF LONG RANGE ORDER AND VACANCY CONTENT IN THE NIAL BETA-PRIME-PHASE ALLOYS BY X-RAY DIFFRACTOMETRY

M. KOGACHI, S. MINAMIGAWA, and K. NAKAHIGASHI (Osaka Prefecture, University, Sakai, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, no. 6, June 1992, p. 1113-1120. refs

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The long range order in the beta-prime-phase alloys Ni(1-c)Al(c) (c values between 0.46 and 0.54) with L2(0)-type structure was investigated by powder X-ray diffractometry. Integrated intensities for eight reflections distributed over a wide angle range were measured and a least-squares calculation was performed based on the profile fitting method. In the Al-rich side, the concentration of vacancies and their preferred lattice site were determined. The results were summarized as: (1) the atomic arrangement on the Ni-rich side attained practically the maximum ordered state; (2) the vacancy content on the Al-rich side increased linearly with Al content; and (3) the vacancies preferentially occupied the Ni-sites (with a probability of about 3/4), while a major portion of Ni and Al atoms occupied their own sites. These conclusions were supported by performing a Rietveld analysis for all the samples. Author

A92-41865

HIGH TEMPERATURE INTERMETALLICS - WITH PARTICULAR EMPHASIS ON TIAL

M. YAMAGUCHI (Kyoto University, Japan) (Institute of Metals, Conference on High Temperature Intermetallics, London, England, Apr. 30-May 1, 1991) Materials Science and Technology (ISSN 0267-0836), vol. 8, no. 4, April 1992, p. 299-307. refs

Copyright

Japan initiated a national project for the development of high-temperature intermetallics in 1989 which has targeted TiAl, due to its promising mechanical and high temperature oxidation properties. A development-status report is presented for TiAl and comparably promising intermetallics, such as CoTi, MoSi₂, and Nb₃Al. Attention is given to such technology demonstrating structural intermetallic components as low-pressure countergravity-cast turbocharger impellers and precision-cast gas turbine inlet vanes and blades. O.C.

A92-42272

DEFORMATION MECHANISMS IN AN (ALPHA + ALPHA2) TWO-PHASE Ti-15 AT. PCT AL ALLOY AT ELEVATED TEMPERATURES

KENICHIRO NIIMI, KENJI MORII, and YUTAKA NAKAYAMA (Osaka Prefecture, University, Sakai, Japan) Zeitschrift fuer Metallkunde (ISSN 0044-3093), vol. 83, no. 5, May 1992, p. 319-323. refs

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Deformation characteristics of a two-phase Ti-15 at. pct Al alloy consisting of alpha-Ti (hcp) and alpha₂ (DO₁₉, Ti₃Al) phases have been investigated at several temperatures between 300 K and 1173 K by means of compression tests and TEM. The two-phase samples were composed of homogeneously distributed ellipsoidal coherent precipitates of alpha₂ with a volume fraction of about 0.45. The 0.2 pct offset yield stress was increased by about 1.5 times as high as that for the solution-treated samples below 873 K, but decreased gradually with increasing temperature. The deformation modes were classified into three types depending on the deformation temperature: the cutting mechanism operates up to 873 K, both cutting and climbing mechanism occur at a temperature between 873 K and 1073 K, and viscous glide of dislocations is preferred above 1183 K. Author

A92-43847

THE FORMATION OF TITANIUM ALUMINIDES ON ALUMINIUM SURFACES BY CO₂ LASER ALLOYING

KEISUKE UENISHI, AKIYOSHI SUGIMOTO, and KOJIRO F. KOBAYASHI (Osaka University, Suita, Japan) Zeitschrift fuer Metallkunde (ISSN 0044-3093), vol. 83, no. 4, April 1992, p. 241-245. refs

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The formation of titanium aluminides on Al surface was examined by CO₂ laser alloying of preplaced Al and Ti powders. By changing the composition of the mixture of Al and Ti and laser irradiating parameters, condition optimization had been achieved to obtain the most reasonable alloyed layer. This synthesized alloyed layer was confirmed to be TiAl₃ by X-ray diffraction and energy dispersive X-ray analyses. The maximum Vickers hardness exhibited about 450 HV and the improvement of wear resistance owing to the surface alloyed layer was recognized by the abrasion test. Author

A92-44661

THE EFFECT OF MICROSTRUCTURE ON FATIGUE CRACK GROWTH IN Ti-6Al-4V ALLOY

TAKESHI OGAWA (Gifu University, Japan), KOHJI OHYA (Daido Steel, Ltd., Nagoya, Japan), and KEIRO TOKAJI (Gifu University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 463, April 1992, p. 502-508. In Japanese. refs

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The characteristics of fatigue crack growth were investigated in Ti-6Al-4V alloy with three kinds of microstructure. The effect of microstructure on the crack growth behavior is attributed to the development of crack tip shielding, resulting primarily from the role of the crack path morphology in inducing crack closure and crack deflection. Roughness-induced crack closure played an important role in the near-threshold growth behavior at the load ratio of 0.05, but the growth rate data plotted in terms of effective SIF range still exhibit the effect of microstructure. Fractographic observations using SEM and image processing enabled 3D observation using a stereo pair of SEM micrographs. The roughness was evaluated quantitatively by the ratio of the total area of the 3D fracture surface to its projected area. The results indicate that the intrinsic crack growth resistance is the same for all microstructures. Thus, fracture surface roughness is a controlling parameter of the fatigue crack growth in the alloy. C.D.

A92-44871

EFFECTS OF NB ADDITION ON THE MICROSTRUCTURE OF Ti-Ni ALLOYS

MIN PIAO, SHUICHI MIYAZAKI, KAZUHIRO OTSUKA, and

NORIMASA NISHIDA (Tsukuba, University, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 4, April 1992, p. 337-345. refs
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The effect of composition on the microstructure (Ms) and the Ms transformation temperature of Ti-Ni-Nb memory shape ternary alloys was investigated for three types of alloys covering a wide composition range: Ti(50-x/2)Ni(50-x/2)Nb(x), Ti50Ni(50-x)Nb(x), and Ti(50-x)Ni50Nb(x). Microstructures were investigated using optical microscopy, SEM, EMPA, XRD, and DSC. It was found that Ti(50-x/2)Ni(50-x/2)Nb(x) alloys exhibited eutectic microstructure characterized by lamellar structures; for this alloy, a pseudobinary 'TiNi-Nb' phase diagram was proposed, and the microstructural change with Nb content was consistently explained by this phase diagram. The results of the Ms measurements for the three types of alloys as a function of Nb addition showed that the Ms temperatures in these alloys were dependent on the Ni/Ti ratio in the B2 phase. I.S.

A92-44872
CHARACTERISTICS OF DEFORMATION AND TRANSFORMATION IN Ti44Ni47Nb9 SHAPE MEMORY ALLOY
MIN PIAO, SHUICHI MIYAZAKI, and KAZUHIRO OTSUKA (Tsukuba, University, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 4, April 1992, p. 346-353. refs
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The mechanical behavior of Ti44Ni47Nb9 shape memory alloy and the effect of deformation on the martensitic transformation in this alloy were investigated by performing tensile tests at various temperatures and electrical resistance measurements. A new effect was found in the 873 K I.Q. specimen, in which electrical resistance vs. temperature curve was remarkably widened by deformation. It is concluded that the deformation promoted the subsequent thermal martensitic nucleation. I.S.

A92-44873
ELECTRON MICROSCOPY STUDY OF TWINS IN MARTENSITE IN A Ti-50.0 AT. PCT NI ALLOY
T. ONDA (Tsukuba, University, Japan), Y. BANDO (National Institute for Research in Inorganic Materials, Tsukuba, Japan), T. OHBA (Teikyo University, Utsunomiya, Japan), and K. OTSUKA (Tsukuba, University, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 4, April 1992, p. 354-359. refs
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Twins in the martensite of a Ti-50.0 Ni (at. pct) alloy were studied. The various twin boundaries were observed by HREM, including those of 011-line-type Type II twin, -1 -1-1 plane-type Type I twin, and new twinning mode of (001) compound twin. Type II twins were confirmed to be a lattice invariant shear. I.S.

A92-44875
DUCTILITY OF HIGH PURITY TiAl INTERMETALLIC COMPOUND
YOSHINORI MURATA, MASAHIKO MORINAGA, and YOSHIKAZU TAKEDA (Toyohashi University of Technology, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 4, April 1992, p. 419-421. Research supported by MOESC. refs
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A high-purity Ti-50 mol pct Al intermetallic compound was found to be ductile having the fracture strain of more than 3 percent. The purification induced a large change in the microstructure. A single TiAl phase with smooth grain boundaries was observed. This is in contrast with the lamellar structure consisting of Ti3Al and TiAl with zigzag grain boundaries in the ordinary purity TiAl with the same composition. Author

A92-47377
EFFECT OF LAMINATED FRACTURE ON THE LOW TEMPERATURE ABSORBED ENERGY IN 5083 ALUMINUM ALLOY
YOSHIHIRO NAKAYAMA and TETSUYA TAKAAI (Yamanashi University, Kofu, Japan) Japan Institute of Light Metals, Journal

(ISSN 0451-5994), vol. 42, no. 4, April 1992, p. 191-197. In Japanese. refs
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The low-temperature toughness of 30-percent cold rolled and annealed 5083 aluminum alloy was studied with the Charpy impact test, and the effect of laminated fracture on the absorbed energy was investigated experimentally. Absorbed energy measured at 77 K was markedly increased by cold rolling. The increasing of the absorbed energy was due to increases in the fractured surface increased by the laminated fracture. Absorbed energy per unit area of the true fractured surface was decreased. Generation and propagation characteristics of the laminated fracture were enhanced by annealing treatment at 473 K for 60 ks. Laminated fracture, however, was reduced by annealing treatment at 523 K or 573 K. The effect of side grooves was to constrain the growth of laminated cracks in the vicinity of specimen ligament. Laminated fracture was observed across the specimen ligament in the specimens with side grooves. Author

A92-47379
EVALUATION OF REFRACTORY MATERIALS FOR MOLTEN ALUMINUM-LITHIUM ALLOYS
MASAYASU TOYOSHIMA, YOSHIKI WATANABE (Sumitomo Light Metal Industries, Ltd., Technical Research Laboratories, Nagoya, Japan), and KAZUYOSHI OKA (Sumitomo Light Metal Industries, Ltd., Technical Research Laboratories, Nagoya; Alithium, Ltd., Yokkaichi Laboratory, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 4, April 1992, p. 230-235. In Japanese. refs
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In order to determine the materials for containment of the molten Al-Li alloys and those for tools and assemblies for melting, the corrosion resistance of various refractory materials to Al-Li melts is evaluated by visual inspection, X-ray diffraction, and chemical analysis. It is found that not only the advanced ceramics but also single or dual phase oxides such as Al2O3, Al2O3-MgO and Al2O3-SiO2 have good corrosion resistance. Author

A92-47605
ELECTRON MICROSCOPY STUDIES OF Ti-47 AT. PCT AL POWDER PRODUCED BY PLASMA ROTATING ELECTRODE PROCESS
M. NISHIDA, T. TATEYAMA, R. TOMOSHIGE, K. MORITA, and A. CHIBA (Kumamoto University, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 27, no. 3, Aug. 1, 1992, p. 335-340. refs
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The microstructures of a plasma rotating electrode-processed Ti-Al alloy consisting of TiAl(gamma) and Ti3Al(alpha-2) in the room temperature equilibrium state are characterized. This alloy is more ductile than single-phase TiAl. Both a martensitic-phase 'M' powder and a dendritic-structure 'D' powder are identified; the former consisted of alpha-2 lath plates, and the latter of alpha-2/gamma lamellae and gamma phases decomposed in the alpha-2 matrix. O.C.

A92-48251
PROBABILITY DISTRIBUTION OF LIFE TIMES OF STRESS CORROSION CRACKING OF 7075 ALUMINUM ALLOY
SHUHEI OHSAKI (Yamaguchi University, Ube, Japan) and TSUNEO TAKAHASHI (Chiba Institute of Technology, Narashino, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 5, May 1992, p. 268-273. In Japanese. refs
Copyright

Life time to stress corrosion cracking (SCC) of an aluminum alloy A7075-T6 in 3.5 percent NaCl solution or in pure water was measured under a stress along short transverse direction. SCC process is divided into crack initiation stage and crack propagation stage, and each stage is analyzed by the Weibull's distribution method. In NaCl solution the life time for each stage can be described by a composite Weibull's distribution. The shape parameter of mode 1 in the region with shorter life time is larger than unity, and that of mode 2 in the region with longer life time

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is close to unity. On the other hand, the life time in pure water follows a single Weibull's distribution with the shape parameter around unity. An average life time is smaller in NaCl solution than in pure water by a factor of two to four. In SCC process of mode 1 in NaCl solution, cracks nucleate at the intergranular corrosion pits. Author

A92-48257

STRUCTURAL STUDY OF LIQUID BI-GA ALLOYS WITH MISCIBILITY GAPS

MASANORI INUI and SHIN'ICHI TAKEDA (Kyushu University, Fukuoka, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1585-1589. refs Copyright

In the liquid binary alloy systems whose phase diagram display a miscibility gap such as the two-phase separation, it is well known that there are large concentration fluctuations just above T_c at which the miscibility gap closes. The structure of liquid Bi-Ga alloys has been examined by neutron scattering measurements. A remarkable change in the structure factor was observed at around 70 at. pct Ga, a composition that corresponds to the maximum temperature in the curve where the miscibility gap closes. The concentration variation of the observed structure factors is discussed in thermodynamic terms. C.D.

A92-48286

A LARGE TENSILE ELONGATION INDUCED BY CRYSTALLIZATION IN AN AMORPHOUS AL(88)NI(10)CE(2) ALLOY

AKIHISA INOUE, YEONG-HWAN KIM, and TSUYOSHI MASUMOTO (Tohoku University, Sendai, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 5, May 1992, p. 487-490. Research supported by Light Metal Educational Foundation, Inc. refs Copyright

An Al(88)Ni(10)Ce(2) amorphous alloy with the two-stage crystallization process of amorphous to amorphous-plus-fcc-Al to Al-plus-compounds exhibited a large elongation reaching 45 percent in the temperature range of 450 to 465 K. The temperature range agrees with that where the primary Al particles with a size of about 12 nm precipitate homogeneously at an interparticle spacing of about 6 nm in the amorphous matrix. It is therefore concluded that the appearance of the significant elongation is due to a crystallization-induced elongation phenomenon. The new phenomenon may be interpreted to occur through the sequent processes of inhomogeneous deformation along shear plane, followed by preferential precipitation of Al particles on the shear plane resulting from the deformation-induced increase in temperature and then propagation of the deformation site to other site resulting from the precipitation-induced strengthening in the deformed area. Author

A92-48287

INCREASE IN MECHANICAL STRENGTH OF NI-SI-B AMORPHOUS ALLOYS BY DISPERSION OF NANOSCALE FCC-NI PARTICLES

AKIHISA INOUE, T. SHIBATA, and TSUYOSHI MASUMOTO (Tohoku University, Sendai, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 5, May 1992, p. 491-496. refs Copyright

Tensile fracture strengths, Young's modulus, and hardness higher than those of corresponding amorphous single-phase alloys, in conjunction with enhanced fracture elongation, are obtained for Ni-base amorphous alloys having a homogeneous dispersion of nanoscale fcc-Ni particles and a composition range of 5-14 percent Si and 7-15 percent B. The highest performance is found for Ni-10Si-9B. The increase of tensile fracture strength by fcc-Ni dispersion may be due to these particles' exceeding of the amorphous phases' mechanical strength, because of the absence of internal effects; they may also act as a barrier for the suppression of amorphous matrix shear deformation. O.C.

A92-48288

DUCTILITY OF UNDOPED NI3Al

AKIHIKO CHIBA, SHUJI HANADA, SADA O WATANABE (Tohoku University, Sendai, Japan), TAKESHI OBANA, KAZUO TANOSAKI, and MASAYOSHI FUJITA (Iwate University, Morioka, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 5, May 1992, p. 503-508. refs Copyright

Ductility of binary Ni3Al alloys having Al concentrations ranging from 23 to 26 mol pct has been investigated using tensile tests. It was found that a recrystallized Ni-23Al alloy exhibits elongation of approximately 5 percent. Recrystallized Ni-23 to 26Al alloys prepared in the present investigation were confirmed to be gamma-prime single phase by optical and transmission electron microscopy. Elongation of recrystallized alloys decreases with increasing Al concentration from 23 mol pct to stoichiometry and recrystallized alloys containing more than 25 percent Al exhibit almost no elongation at 290 K. This ductilization behavior in Ni-rich Ni3Al alloys is explained by considering both Ni segregation to grain boundaries and decrease in ordering energy, caused by deviation away from stoichiometry. Author

A92-48400

DUCTILITY IMPROVEMENT OF TI-MO ALLOY DUE TO TITANIZING

YOSHITO TAKEMOTO, MORITAKA HIDA, AKIRA SAKAKIBARA (Okayama University, Japan), and NORIHIDE NISHIDA (Okayama Prefecture, Industrial Technical Center, Okayama, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 5, May 1992, p. 524-530. In Japanese. refs Copyright

A92-49143

POSSIBILITY OF GRAIN REFINEMENT FOR SUPERPLASTICITY OF A MG-AL-ZN ALLOY BY PRE-DEFORMATION

HIROHIKO TAKUDA, SHIOMI KIKUCHI, and NATSUO HATTA (Kyoto University, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 4, Feb. 15, 1992, p. 937-940. Research supported by MOESC. refs Copyright

For a commercial Mg-Al-Zn alloy sheet, tensile tests are carried out under various strains, strain rates, and temperatures to investigate the possibility of grain refinement by dynamic recrystallization during predeformation. It is found from the microstructural observations that relatively fine grains of 10 microns or so in diameter are attained under the conditions of 250 C and 8.3×10^{-4} /sec. The specimen prestrained under this condition also exhibits a fairly good superplasticity of total elongation beyond 300 percent. Author

A92-49713

HIGH TEMPERATURE OXIDATION OF TWO-PHASE (Ti3Al + TiAl) INTERMETALLIC COMPOUNDS

AKITO TAKASAKI, KOZO OJIMA, YOUJI TANEDA (National Defense Academy, Yokosuka, Japan), TAJI HOSHIYA (Japan Atomic Energy Research Institute, Oarai), and AKIRA MITSUHASHI (Mitsubishi Materials Corp., Omiya, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 27, no. 4, Aug. 15, 1992, p. 401-405. refs Copyright

AEM cross-sectional analyses are presently used to characterize the high-temperature oxidation behavior of the two-phase Ti3Al-TiAl intermetallic at 1273 K for 24 hr. The internal oxidation zone observed was about 4 microns wide and consisted of both Al2O3 paths and the Ti3Al phase. The Al2O3 paths precipitated at the original lamellar boundary, and then grew into the TiAl phase which had been present before heating. This suggests that the Al which formed the Al2O3 paths came primarily from the Al-rich TiAl phase, rather than from the Ti-rich Ti3Al, as well as that oxygen diffuses into the compound's matrix. O.C.

A92-49714

LONG-RANGE ORDER IN L1(2) TERNARY INTERMETALLIC COMPOUNDS AL₃Ti-X (X = Fe, Ni, Cu, Ag)

M. KOGACHI, S. MINAMIGAWA, and K. NAKAHIGASHI (Osaka Prefecture University, Sakai, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 27, no. 4, Aug. 15, 1992, p. 407-412. refs

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The Kogachi et al. (1992) X-ray analysis method for ascertaining the long-range order of a ternary alloy system, involving a least-squares fitting calculation based on the profile-fitting method, is presently used to obtain the long-range order of the L1(2)-type structure systems Al₃Ti-Fe, Al₃Ti-Ni, Al₃Ti-Cu, and Al₃Ti-Ag. Powder X-ray diffractometry is used to obtain basic data. The ternary elements are found to preferentially occupy the Al sites in all these systems. Al and Ti atomic arrangement order is most affected by Ag, and least by Ni. O.C.

A92-50867

MORPHOLOGICAL AND CALORIMETRIC STUDIES ON THE AMORPHIZATION PROCESS OF ROD-MILLED AL₅₀ZR₅₀ ALLOY POWDERS

M. S. EL-ESKANDARANY, KIYOSHI AOKI, and KENJI SUZUKI (Tohoku University, Sendai, Japan) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol. 23A, no. 8, Aug. 1992, p. 2131-2140. refs

(Contract MOESC-03555139; MOESC-03302053)

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The amorphization and crystallization processes of Al-Zr alloy powders that were mechanically alloyed by rod-milling have been characterized via SEM, TEM, XRD, DTA, and DSC. It is established that the amorphous alloy occurs in three stages, namely agglomeration, disintegration, and homogenization. An amorphous phase is created at about 880 K through the heating of many fine layers of Al and Zr formed at the disintegration stage. The similarity of the mechanical alloying amorphization process to that of the interdiffusion reaction in multilayered thin films is corroborated. O.C.

A92-52158

ICOSAHEDRON AND ICOSAHEDRAL ORDER IN RAPIDLY SOLIDIFIED AL-NI-MO ALLOYS

A. NIKURA, A. P. TSAI, A. INOUE, and T. MASUMOTO (Tohoku University, Sendai, Japan) Scripta Metallurgica et Materialia (ISSN 0956-716X), vol. 27, no. 5, Sept. 1, 1992, p. 543-548. refs

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While the amorphous phase of the Al-Ni-Mo system is found over the 10-25 at. pct Ni and 5-15 at. pct composition range, the icosahedral 'i-phase' is encountered in an area adjacent to the amorphous phase formation region in the Al greater than 80 at. pct side. Amorphous Al-10Ni-5Mo has a correlation length of icosahedral order of 3-5 nm; this is crystallized via i-phase to a crystalline Al₁₂Mo whose structure is different from the amorphous-to-icosahedral phase range in a unique fashion that is dependent on the density and connectivity of the icosahedrons obtained by annealing and quenching. O.C.

A92-52400

P/M MATERIALS FROM RAPIDLY SOLIDIFIED FLAKES OF AZ91 BASED MAGNESIUM ALLOYS

TOSHIYUKI SATO, JUNICHI KANEKO, and MAKOTO SUGAMATA (Nihon University, Narashino, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 42, no. 6, June 1992, p. 345-351. In Japanese. refs

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This experiment demonstrates the fabrication of rapidly solidified flakes of AZ91 magnesium-based alloys with selective additions of Si, Ni, or Ce. Cold pressing and hot extrusion are employed at a reduction ratio of 25:1 to produce the materials, and higher tensile strengths are reported for the as-extruded materials. It is shown that P/M materials with high specific strength and ductility can be obtained through the rapid solidification of magnesium-based alloys. C.C.S.

A92-53514

TENSILE PROPERTIES OF LE-7 TURBINE BLADE MATERIALS IN HIGH PRESSURE HYDROGEN

MAKOTO YOSHIDA, YOSHIAKE WATANABE, KENJIRO KAMIJO (National Aerospace Laboratory, Kakuda, Japan), and YOSHIMASA TAJIMA (NASDA, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 469-476. refs

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Tensile tests have been conducted on turbine blade materials which are to be used on the LE-7 engine of the H-II launch vehicle under conditions which simulate actual turbine driving conditions. The turbine blades, test facility and procedures are briefly described. Test results, including stress-strain curves, ultimate tensile strengths, and the effect of hydrogen embrittlement on Inconel 718 and MAR-M247 LC DS materials are reported. C.D.

A92-53519

DEVELOPMENT TESTS OF NICKEL SUPER ALLOYED THERMAL PROTECTION SYSTEM FOR SPACECRAFTS

KATSUhide KITAMURA, MASAaki ICHIKAWA (Ishikawajima-Harima Heavy Industries Co., Ltd., Space Development Div., Tokyo, Japan), MASATAKA YAMAMOTO, and TOMOYUKI KOBAYASHI (NASDA, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 507-512. refs

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For a thermal protection system (TPS) ranging from 550 C to 1100 C, a three-layered, sandwich-type TPS was selected. The layers are made of nickel superalloyed honeycomb, blanket-type heat insulator, and highly rigid insulator. A honeycomb plate and a side wall are made of INCONEL 617 thin foil ranging from 38 to 100 microns. 305mm x 305mm unit pieces were subjected to thermal and mechanical loads to verify their load endurance performance. To upgrade the thermal and weight characteristics of the TPS, thermal shock tests were conducted using a plasma arc heater and fabrication methods were examined for weight reduction. Author

A92-53986

NITROGEN-INDUCED AMORPHIZATION OF TI-ZR POWDERS DURING MECHANICAL ALLOYING

K. AOKI, A. MEMEZAWA, and T. MASUMOTO (Tohoku University, Sendai, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 9, Aug. 31, 1992, p. 1037-1039. refs

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A mixture of elemental powders of Ti and Zr which exhibit complete solid solubility is mechanically alloyed by a high-energy ball mill at room temperature under a controlled nitrogen atmosphere. The products were characterized by X-ray diffraction, transmission electron microscopy, differential scanning calorimetry, and chemical analysis. Nanocrystalline fcc type c-TiZrN_{0.9} powders were prepared by MA in 2 MPa of nitrogen gas. On the contrary, amorphous a-TiZrN_{0.3} alloy powders were synthesized by MA in 0.04 MPa of nitrogen gas. Author

A92-54449

APPLICATION OF RF PLASMA SPRAYING TO FABRICATION OF INTERMETALLIC MATRIX COMPOSITE COATINGS

MASAHIRO FUKUMOTO (Toyohashi University of Technology, Japan) and M. I. BOULOS (Sherbrooke University, Canada) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 6, June 1992, p. 678-683. In Japanese. refs

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Ti₃Al intermetallic compounds coatings were fabricated under just-as-sprayed conditions by RF plasma spraying without heat treatment afterward. An unsuccessful attempt was made to produce Ti₃Al intermetallic coatings by the DC plasma spray process. C.D.

A92-54450

EFFECTS OF DEOXIDIZER ADDITION ON THE HYDROGEN PERMEATION CHARACTERISTICS OF V-NI ALLOY MEMBRANES

MASAO KOMAKI, CHIKASHI NISHIMURA, and MUNETAKI AMANO (National Research Institute for Metals, Tokyo, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 6, June 1992, p. 729-733. In Japanese. refs

Copyright

The effects of solute oxygen atoms on the hydrogen permeability and diffusivity in V-15 at pct Ni alloy membranes have been investigated. In order to remove the solute oxygen atoms, a suitable amount of the deoxidizer such as Y, Ti, or Zr was added during arc-melting the alloy. The hydrogen permeability and diffusivity of the alloy samples plated with Pd were determined using the gas permeation and time-lag methods in the temperature range 373 to 673 K. The samples added a suitable amount of Y, Ti, or Zr showed higher hydrogen permeabilities and diffusivities above 473 K, than a sample without the deoxidizer. Below about 473 K, however, these samples showed a hydrogen trapping phenomenon, just like a sample without the deoxidizer. It is considered that solute oxygen atoms in the alloy decrease the effective area for hydrogen permeation. The hydrogen trapping phenomenon observed below about 473 K is considered to be caused mainly by surface effects. Author

A92-54473

HIGH RESOLUTION TEM OBSERVATIONS OF SUPERDISLOCATIONS IN Ni₃(Al,Ti)

TAKESHI KAWABATA, DAISUKE SHINDO, and KENJI HIRAGA (Tohoku University, Sendai, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 6, June 1992, p. 565-570. refs

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The end-on images of superdislocations were observed with high-resolution TEM in Ni₃(Al,Ti) single crystals deformed at 683 and 293 K. The observations showed that the superdislocations dissociate into superpartials bound by a superlattice intrinsic stacking fault (SISF) type of dislocation and antiphase boundary type of dislocation. O.G.

A92-54474

CRYSTALLOGRAPHY OF ALPHA PHASE PRECIPITATED ON DISLOCATIONS AND DEFORMATION TWIN BOUNDARIES IN A BETA TITANIUM ALLOY

TADASHI FURUHARA, HIDEYUKI NAKAMORI, and TADASHI MAKI (Kyoto University, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 6, June 1992, p. 585-595. Research supported by Tanigawa Foundation. refs

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TEM was used to study crystallographic orientation relationship of alpha phases precipitated on dislocations and deformation twin boundaries in the beta matrix of a Ti-15V-3Cr-3Sn-3Al alloy. Specimens were aged at 933 K after being slightly rolled at 77 K. It was found that alpha plates precipitate preferentially on the dislocations in the slip bands. In the same slip bands, alpha plates select particular variants of the Burgers orientation relationship. The selectivity of variants is considered in terms of the effective relaxation of the transformation strain by the stress field associated with the dislocation. O.G.

A92-54863

STUDY ON MECHANICAL PROPERTIES OF Ti ALLOY BRAZED JOINT WITH NEWLY DEVELOPED Pd ALLOYS AND OTHER HIGH TEMPERATURE FILLER MATERIALS

YOSHIFUMI SUEZAWA (Nihon University, Tokyo, Japan) IN: Advances in joining newer structural materials; Proceedings of the International Conference, Montreal, Canada, July 23-25, 1990. Oxford and Elmsford, NY, Pergamon Press, 1990, p. 223-228.

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Filler materials for brazed joints are experimentally developed with the aim to optimize strength, spreadability, and wettability as well as mechanical properties and heat resistance. The three filler materials - Pd-Cu-Co, Au-Pd-Cu, and Ni-Cr-W-Fe-B-Si - are used

to braze the base metal Ti-6Al-4V joints in a 7-kW resistance heating vacuum furnace. The brazed joints are examined by means of microscopy to study microstructural defects, and high-temperature tensile tests are conducted. The most suitable materials for brazing titanium joints are found to be the Pd-Cu-Co and Ni-Cr-W-Fe-B-Si fillers. Good spreadability and wettability are reported along with a good tensile strengths at room and higher temperatures, and no cracks, voids, or inclusions are observed in the samples. C.C.S.

A92-55886

ENHANCEMENT OF FRACTURE TOUGHNESS OF NEAR BETA TITANIUM ALLOY DUE TO FORMATION OF HYDRIDES

AKIRA NOZUE, KENJI KASUGA, TOMOO WATANABE, and TADATSUNE OKUBO (Sophia University, Tokyo, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 7, July 1992, p. 735-740. In Japanese. refs

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A transformation-toughening method has been known to enhance fracture toughness for ceramics. In the present study, nearly the same type of method has been developed to increase the fracture toughness of a material. A near beta type of Ti alloy was utilized as a model of the transformation toughening. Specimens were cathodically charged at 303 K and then baked at 473 - 673 K in a vacuum furnace in order to form hydrides only on alpha precipitates. Fracture toughness tests were carried out with CT specimens of 10-mm thickness. At almost the same strength levels, only the fracture toughness was increased up to about 20 percent mainly due to the transformation of the alpha phase to hydrides. The hydrides were confirmed by a TEM and hydrogen content measurement. Therefore, the present method made it possible to increase the fracture toughness and to retain the high strength. Author

A92-56103

TITANIUM ALLOY CASTING FOR AEROSPACE

SHOHEI HAMAI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 466-469. In Japanese. refs

Recent advances in foundry technology have enabled titanium/graphite and investment castings to be applied to large, more complex and critical application, these technologies include large part size capability, HIP, preformed core, alternate alloys, and heat treatments, and rigorous quality and process controls. The mechanical properties, characteristics, and applications of titanium alloy castings are reported. Author

A92-56104

PROPERTIES OF THE SUPERPLASTIC 7475 AL ALLOY 'T5' - CONDITION AND USAGE

WATARU ASAI, NOBUYUKI SUZUKI, KIYOSHI WATANABE (JAHC, Japan), and MIKIO SASAZIMA (Japan Aircraft Development Corp., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 470-473. In Japanese.

Static tension and fatigue tests on the superplastic 7475 aluminum alloy 'T5' are presented. The processing method and heat treatment are discussed. Y.P.Q.

A92-56105

PRESENT STATUS OF AL-Li ALLOYS

TOSIO SAKAKIBARA, ENJI TANIKAWA, and OSAMU MISHIWAKI (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 474-477. In Japanese.

Al-Li alloys have low density and high modulus, which makes them attractive for advanced airframe structure. Formerly, the alloy 2020 was developed and used. However, application of the alloy was limited to only RA-5C due to low ductility and low fracture toughness of the alloy. The work began in the 1970s, when aluminum producers accelerated the development of Al-Li alloys

as replacements for conventional airframe alloys. The mechanical properties of Al-Li alloys such as 2090, 2091, 8090, are described in this paper. Author

A92-56578

EFFECT OF OXYGEN ADDITION ON MECHANICAL PROPERTIES OF TiAl AT 293-1273 K

T. KAWABATA, T. ABUMIYA, and O. IZUMI (Tohoku University, Sendai, Japan) *Acta Metallurgica et Materialia* (ISSN 0956-7151), vol. 40, no. 10, Oct. 1992, p. 2557-2567. Research supported by Light Metal Educational Foundation, Inc. refs
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The mechanical properties of Ti-Al alloys (50, 53, and 56 percent Al; 0, 0.1, 0.2, and 0.3 percent oxygen by mass) were investigated experimentally under compressive loading in the temperature range 293-1273 K in vacuum. It is found that the addition of 0.3 percent oxygen to alloys with 50 and 56 percent Al leads to factor of 1.5 increase in the yield stress and the work hardening coefficient as compared with oxygen-free TiAl alloys. However, no change in the yield stress and the work hardening coefficient is observed in the alloy with 53 percent Al. The addition of oxygen leads to a structural refinement in all the alloys studied, with a fine lamellar structure produced in the 50-percent Al alloy and a finer dendritic structure formed in alloys with 53 and 56 percent Al. V.L.

A92-56582

ANELASTIC STUDY OF SCREW-DISLOCATION MOTION IN HIGH-PURITY NIOBIUM

H. MIZUBAYASHI, M. MORITA, T. KAKIHARA, and S. OKUDA (Tsukuba, University, Japan) *Acta Metallurgica et Materialia* (ISSN 0956-7151), vol. 40, no. 10, Oct. 1992, p. 2651-2659. refs
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The kink pair formation (KPF) on screw dislocations in high-purity Nb was investigated by anelastic creep measurements. The activation enthalpy for KPF and the preexponential factor of the reciprocal of the relaxation time are determined. The results obtained are found to be similar to results reported for Fe. V.L.

A92-57037

ESTIMATION OF THE VACANCY PROPERTIES IN ORDERED Ni3Al ALLOYS BY CLUSTER VARIATION METHOD

T. SHINODA, H. HOSODA, Y. MISHIMA, and TOMOO SUZUKI (Tokyo Institute of Technology, Japan) *JIM, Materials Transactions* (ISSN 0916-1821), vol. 33, no. 7, July 1992, p. 698-705. refs
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Attention is given to a novel calculative technique based on the cluster variation method, in which the problem of determining the vacancy concentration in an ordered Ni₃Al alloy is reduced to finding a critical condition for the chemical potential of vacancy in the alloy to be vanished. This method together with an appropriate interaction parameter for each nearest-neighbor atomic pair, e.g., between Ni (or Al) and vacancy, are used to calculate the vacancy concentration, c_3 , in this alloy. These calculated values are comparable with the available experimental or theoretical data for c_3 in this alloy system. On the basis of the present results, the vacancy formation energy for each sublattice site of the alloy crystal structure is estimated to be a reasonable value compared with the available data from experiments or different theoretical estimates. An alternative way to roughly estimate the vacancy formation energy in Ni₃Al alloys is proposed. P.D.

A92-57038

ABNORMAL GRAIN GROWTH IN OXIDE DISPERSION STRENGTHENED Ni-BASE SUPERALLOY

SAM S. KIM and SHUJI HANADA (Tohoku University, Sendai, Japan) *JIM, Materials Transactions* (ISSN 0916-1821), vol. 33, no. 7, July 1992, p. 706-709. refs
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To examine the predominant factor controlling abnormal grain growth of Ni-base oxide dispersion strengthened superalloy, microstructures were investigated using SEM and TEM. Three kinds of particles were recognized: (1) fine, round shape of yttria particles of 10 to 80 nm in diameter, (2) large, round shape of Al and Ti

oxide particles of 80 to 200 nm diameter, and (3) flake shape of Cr rich phase with sizes of 0.2 to 0.4 micron in width and 0.4 to 2.5 microns in length. It was found that the major pinning obstacles of abnormal grain growth were the Cr-rich phase. Author

N92-12099# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.

STRENGTH EVALUATION FOR MODIFIED 12CR STEEL AND A286 STEEL OF USC TURBINE ROTOR MATERIALS

TAKASHI OGATA and AKITO NITTA 1990 38 p In JAPANESE; ENGLISH summary
(DE90-503033; CRIE-T-88082) Avail: CASI (US Sales Only) HC A03

As candidate materials of the ultra super critical (USC) turbine rotor in a coal fired power plant, the modified 12Cr steel and A286 steel are subjects of the study under the first step steam condition (316 atg, 593 C) and under the second step steam condition (350 atg, 650 C), respectively. The strength evaluation tests of the modified 12Cr steel, untreated material, and aging (630 C, 4860 hours) of material 1 were conducted previously, and obtained a prospect that the material could be applied to the first step turbine rotor. In this report, the strength evaluation tests and microstructure observation of the long period aging (630 C, 8190 hours) of material 2 and the strength tests of the A286 steel have been conducted. As a result, it was found that the modified 12Cr steel is a stable material in the microstructure and has enough strength characteristics to apply the first step rotor, and that the A286 steel also can be applied to the second step rotor. DOE

N92-15173# Japan Atomic Energy Research Inst., Tokyo.

CREEP CURVE FORMULARIZATION AT 950 C FOR HASTELLOY XR

YOSHIYUKI KAJI (Japan Atomic Energy Research Inst., Tokyo.) and YASUSHI MUTO (Japan Atomic Energy Research Inst., Tokai.) Mar. 1991 67 p In JAPANESE; ENGLISH summary
(DE91-508055; JAERI-M-91-023) Avail: CASI HC A04/MF A01

Creep tests under constant stress were conducted on a nickel-base heat-resistant alloy, Hastelloy XR, in air at 950 C. Minimum creep strain rate, time to the onset of tertiary creep and time to rupture were obtained as a function of applied stress. Then, a creep constitutive equation was made based on the Garofalo formula for primary and secondary creep and based on the Kachanov-Rabotnov formula for tertiary creep, which could represent fairly well the experimental creep deformation curves under the constant stress conditions. The creep deformation under the constant load condition corresponding to the stress increment was analyzed using the creep constitutive equation and strain hardening law. Then the calculated creep strain showed slightly higher value than the experimental creep strain, and the calculated life was shorter than the experimental one. DOE

N92-23263# Japan Atomic Energy Research Inst., Tokyo.

EFFECT OF MINOR ELEMENTS ON HOT WORKABILITY OF Ni-Cr-W SUPERALLOYS

HIROKAZU TSUJI (Japan Atomic Energy Research Inst., Tokai.), HAJIME NAKAJIMA (Japan Atomic Energy Research Inst., Tokai.), TETSUYA SHIMIZU (Japan Atomic Energy Research Inst., Tokai.), and SUSUMU ISOBE Aug. 1991 28 p In JAPANESE; ENGLISH summary

(DE92-750951; JAERI-M-91-116) Avail: CASI HC A03/MF A01

Research and development have been carried out on the new Ni-Cr-W superalloys as a component material for high temperature gas-cooled reactors (HTGR) with coolant outlet temperatures of around 1000 C. The basic composition, Ni - 18 to 19 mass percent Cr - 20 to 22 mass percent W, of the experimental alloys was specified in the first step. Applying this new alloy to reactor components, the alloy with stable qualities should be supplied in an industrial scale. From such a viewpoint, the hot workability is one of the most important indices. Thus, in order to examine the effect of addition of Mn, Si, B, Y, Ti, etc. on the hot workability, a series of high-strain-rate high-temperature tension tests, so-called Gleeble tests, was carried out on 21 heats of Ni - 18 to 19 mass percent Cr - 20 to 22 mass percent W

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alloys at temperatures ranging from 800 to 1300 C at every 50 C for most of the heats, and also at 500, 600 and 700 C for the other heats. Based on the results obtained the following conclusions are drawn: (1) The addition of Mn and Si was extremely harmful to the hot workability. (2) The addition of B was effective to improve the hot workability. (3) The addition of Y was extremely effective to improve the hot workability. The saturation point of the effectiveness was higher than 0.008 mass percent. (4) The addition of Ti was extremely effective to improve the hot workability. Around 0.08 mass percent addition of Ti was enough to exhibit the effectiveness. (5) The addition of Nb, Fe and/or the enrichment of C exhibited no beneficial influence in the aspect of the hot workability substantially. (6) A new Ni-Cr-W superalloy, which shows extremely superior hot workability, has been developed. It will be possible that the new alloy is manufactured in an industrial scale.

DOE

N92-23265# Japan Atomic Energy Research Inst., Tokyo. HYDROGEN ABSORPTION BY ZIRCONIUM ALLOY CLADDING TUBE WITH SURFACE OXIDE FILM

MASAAKI UCHIDA (Japan Atomic Energy Research Inst., Tokai.)
Aug. 1991 37 p
(DE92-750962; JAERI-M-91-132) Avail: CASI HC A03/MF A01

Hydrogen absorption kinetics of Zircaloy (2 and 4) and Zr-Nb (1 percent and 2.5 percent) cladding tubes were studied by heating in hydrogen gas after oxide film formation in steam, oxygen or air. Hydrogen absorption rate depended on the degree of pre-oxidation. In Zr-Nb, the absorption rate was also sensitive to the atmosphere used for pre-oxidation, whereas in Zircaloy the rate was relatively independent of the kind of oxidant. In all materials, pre-oxidation to the transition point was found to bring about high absorption rate in the subsequent hydriding step. After pre-oxidation to the post-transition region, hydrogen absorption rate by Zircaloy showed constant or slightly decreasing tendency with increasing oxidation level, whereas in Zr-Nb, particularly in Zr-2.5 percent Nb, the rate showed a clearly decreasing tendency depending on the pre-oxidation atmosphere. Different characteristics of Zircaloy and Zr-Nb can partly be explained in terms of different valencies of alloying elements which influence the lattice defect concentrations in the oxide films.

DOE

N92-23712# Japan Atomic Energy Research Inst., Tokyo. EFFECT OF MINOR ELEMENTS ON CORROSION BEHAVIOR OF NI-CR-W SUPERALLOYS IN HTGR HELIUM

HIROKAZU TSUJI (Japan Atomic Energy Research Inst., Naka.),
TOMIO SUZUKI (Japan Atomic Energy Research Inst., Naka.),
TAKASHI TSUKADA (Japan Atomic Energy Research Inst., Naka.),
and HAJIME NAKAJIMA (Japan Atomic Energy Research Inst.,
Tokai.) Sep. 1991 50 p
(DE92-751006; JAERI-M-91-136) Avail: CASI HC A03/MF A01

Research and development have been carried out on the new Ni-Cr-W superalloys as a component material for high temperature gas cooled reactors (HTGCs) with coolant outlet temperatures of around 1000 C. The basic composition, Ni-18 to 19 mass percent Cr-20 to 22 mass percent W, of the experimental alloys was specified in the first step. In order to examine the effect of addition of Mn, Si, B, Y and Ti on corrosion behavior in simulated HTGR helium, corrosion tests were carried out on eight heats of Ni-18 to 19 mass percent Cr-20 to 22 mass percent W alloys at 950 and 1000 C. Thermal cycles were given at intervals of 100 h between room temperature and the each test temperature. The cumulative period of exposure to simulated HTGR helium at the each test temperature was 1000 h. Based on the results obtained the following conclusions are drawn: (1) All the Ni-Cr-W alloys tested showed better resistance to general corrosion than Hastelloy XR, and also indicated better stability of the surface oxide film and less susceptibility to intergranular oxidation than the conventional Ni-Cr-W alloys. (2) The addition of Mn and Si showed no advantage. The alloys containing Mn and Si rather showed inferior corrosion resistance in simulated HTGR helium. (3) The addition of B and Y was effective to improve corrosion resistance in simulated HTGR helium. (4) Although the addition of Ti was harmful to corrosion resistance in simulated HTGR helium,

around 0.08 mass percent addition of Ti did not reduce corrosion resistance in the environment. (5) A new Ni-Cr-W superalloy, which shows extremely superior corrosion resistance to conventional Ni-Cr-W superalloys in simulated HTGR helium, has been developed.

DOE

**N92-24581# Japan Atomic Energy Research Inst., Tokyo.
FILLER METAL DEVELOPMENT FOR HASTELLOY ALLOY XR
KATSUTOSHI WATANABE (Tokai Univ., Hiratsuka (Japan).),
HAJIME NAKAJIMA (Japan Atomic Energy Research Inst., Tokai.),
and KENSHO SAHIRA Nov. 1991 87 p
(DE92-768151; JAERI-M-91-181) Avail: CASI HC A05/MF A01**

The present report describes the results of cooperative research in order to evaluate the weldability and properties of Hastelloy alloy XR weldment with the filler metal fabricated on the industrial scale. A series of qualification test was performed using the filler metal, of which the content of the minor elements such as boron was optimized on the basis of the results so far obtained by the filler metal development for Hastelloy alloy XR structure with thin wall. The boron diffusion behavior, weldability, and the properties such as corrosion, aging embrittlement, and high temperature strength were examined on the Hastelloy alloy XR weldment by means of tungsten inert gas arc welding procedure. Based on the excellent weldability and weldment properties as well as the mass production possibility for the filler metal, it is concluded that the filler metals possessing the required performance has been developed.

DOE

N92-25951# National Inst. for Fusion Science, Nagoya (Japan). COMPARISON OF IONIZATION RATE COEFFICIENTS OF IONS FROM HYDROGEN THROUGH NICKEL

TAKAKO KATO, KUNIYAKI MASAI, and M. ARNAUD Sep. 1991
231 p
(DE92-768075; NIFS-DATA-14) Avail: CASI HC A11/MF A03

Ionization rate coefficients based on several empirical formulae are compared with each other for ions from Hydrogen to Nickel. The coefficients are shown illustratively, and the differences are discussed.

DOE

**N92-31163# Japan Atomic Energy Research Inst., Tokyo.
FILLER METAL DEVELOPMENT FOR HASTELLOY ALLOY XR
KATSUTOSHI WATANABE, HAJIME NAKAJIMA, and KENSHO
SAHIRA Nov. 1991 72 p In JAPANESE
(DE92-782044; JAERI-M-91-189) Avail: CASI HC A04/MF A01**

In order to develop the filler metal for Hastelloy alloy XR structure with thick wall, the weldability and high temperature strength properties of Hastelloy alloy XR weldment were investigated using the filler metals, which were alloy-designed on the basis of multiple regression analysis. The former was examined through the chemical analysis in the deposited metal, bend test, FISCO cracking test, optical microscopy, and hardness measurement. The latter was investigated by means of tensile and creep test. It was found from these results that the crack susceptibility in the weldment was apparent to be lowered without degrading the high temperature strength properties. Therefore, it is concluded that these filler metals possess excellent performance as the filler metal for Hastelloy alloy XR structure with thick wall.

DOE

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NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

**A92-10533
SYNTHESIS OF POLYCRYSTALLINE ALUMINA FIBRE WITH
ALUMINIUM CHELATE PRECURSOR**

T. YOGO and H. IWAHARA (Nagoya University, Japan) *Journal of Materials Science* (ISSN 0022-2461), vol. 26, Oct. 1, 1991, p. 5292-5296. refs

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Polycrystalline alumina fiber was synthesized, using pyrolysis of preceramic fiber formed from aluminum chelate compound. EOPA was reacted with glacial acetic acid, yielding a polymeric product. The polymeric precursor was analyzed by infrared spectroscopy, nuclear magnetic resonance, and mass spectroscopy. The C-13 NMR spectrum of EOPA changed from sharp singlets to multiplets after the reaction with acetic acid. The viscosity of the polymeric product increased in intensity with increasing amount of acetic acid. The molecular weight of the precursor was distributed from 400 to 800. The polymeric precursor pyrolyzed at 500 C in air was amorphous to X-rays, and crystallized in gamma-alumina at 840 C. The precursor fibers were pyrolyzed at 1300 C for 1h, to yield fine-grained fibers of alpha-alumina.

O.G.

A92-10617

SIALON CERAMICS BY THE HOT ISOSTATIC PRESS ENCAPSULATION METHOD

K. YABUTA, H. NISHIO, A. KITAMURA (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan), and K. UEMATSU (Nagaoka University of Technology, Japan) *Journal of Materials Science Letters* (ISSN 0261-8028), vol. 10, Oct. 1, 1991, p. 1144, 1145. refs

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The properties of sialons consolidated by the HIP encapsulation method are reported. It is shown, in particular, that the highest bulk density (3.14 g/cu cm) and Vickers hardness (1870) are achieved in specimens HIPed at 1600 C. The microstructure of such specimens is characterized by fine (0.5 micron) grains; the fracture surfaces are nearly flat, showing a transgranular fracture mode. Specimens HIPed at 1700 and 1780 C have grains of approximately 1 micron and exhibit both intergranular and transgranular fracture. The fracture mode and grain size are thought to be the principal factors responsible for the increased toughness of sialons with increasing HIP temperature.

V.L.

A92-11010#

THE DEVELOPMENT OF HIGH-STRENGTH BALLOONS MADE OF NEW MATERIALS

R. AKIBA, H. AKIYAMA, M. FUJII, M. HINADA, Y. INATANI, N. ISHII, J. NISHIMURA, Y. OKABE, N. WATANABE, N. YAJIMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) et al. IN: AIAA International Balloon Technology Conference, Albuquerque, NM, Oct. 8-10, 1991, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 55-60. refs

(AIAA PAPER 91-3663) Copyright

To increase the reliability of balloons for sophisticated and heavy payloads, two types of new balloons made of materials with high resistance values against tear propagation are being developed at the Institute of Space and Astronautical Science. Two different materials, high strength fiber reinforced polyethylene film and rip-stop nylon fabric coated with urethane resin, are used for the construction of these balloons. The model tests of the new balloons, evaluations of the strength of the end fittings and the flight performance of 5000 cu m balloons are described. The future schedules for flights of 15,000 cu m balloons which will carry payloads of 1.3 tons to altitudes of about 20 km are presented.

Author

A92-11853

CYCLIC FATIGUE IN CERAMICS

HIDEHIRO KISHIMOTO (Toyota Technological Institute, Nagoya, Japan) *JSME International Journal, Series I* (ISSN 0914-8809), vol. 34, Oct. 1991, p. 393-403. refs

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The mechanisms of cyclic fatigue are summarized with reference to the fatigue characteristics of available materials, and the comparative effectiveness of the mechanisms is reviewed. After

briefly reviewing the importance of crack propagation to cyclic fatigue, the mechanisms are presented including: (1) crack growth resulting from vacancies and lattice defects; (2) localized tensile residual stress from thermal shrinkage; (3) crack-tip shielding; and (4) the sequential loss of interacting forces between crack faces. Cyclic degradation of the bridging effect is supported by experimental evidence, underscoring the importance of the maximum stress-intensity factor at maximum load. Cyclic-fatigue degradation is reviewed for alumina, silicon nitride, and other ceramics for various conditions such as vacuums and different stress types. Some ceramics do not suffer degradation from cyclic fatigue, and intergranular fractures are important in the study of the degradation when it occurs.

C.C.S.

A92-11985

HIGH-STRENGTH SILICON NITRIDE CERAMICS OBTAINED BY GRAIN-BOUNDARY CRYSTALLIZATION

K. KOMEYA (Yokohama National University, Japan), M. KOMATSU, T. KAMEDA (Toshiba Corp., New Materials Engineering Laboratory, Yokohama, Japan), Y. GOTO, and A. TSUGE (Toshiba Corp., Research and Development Center, Kawasaki, Japan) *Journal of Materials Science* (ISSN 0022-2461), vol. 26, Oct. 15, 1991, p. 5513-5516. refs

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A monolithic type of toughened silicon nitride ceramics is developed from Si₃N₄-Y₂O₃ systems. However, because of the existence of a second phase, the fracture strength decreases at elevated temperatures. To improve the high-temperature strength of silicon nitride, some additional components were investigated. It was found that the addition of hafnia to the Si₃N₄-Y₂O₃-AlN system gave a greater high-temperature strength based on the promotion of grain-boundary phase crystallization: namely, 126 kg/sq mm in 3-point bend strength at 1300 C for the hot-pressed specimen, and 90 kg/sq mm at 1300 C for the pressureless sintered specimen. The role of the hafnia in crystallization is not yet clear, and is being characterized by electron microscopy and microanalysis.

Author

A92-11986

TETRAGONAL-TO-MONOCLINIC PHASE TRANSFORMATION DURING THERMAL CYCLING AND ISOTHERMAL AGEING IN YTTRIA-PARTIALLY STABILIZED ZIRCONIA

H. TSUBAKINO, M. HAMAMOTO, and R. NOZATO (Himeji Institute of Technology, Japan) *Journal of Materials Science* (ISSN 0022-2461), vol. 26, Oct. 15, 1991, p. 5521-5526. refs

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The tetragonal-to-monoclinic (T yields M) phase transformation accompanied with thermal cycling is studied by ionic conductivity, dilatation and X-ray diffraction measurements. With repeating thermal cycling, the Ms point shifts to a higher temperature, the amount of expansion due to T yields M transformation increases, and the transformation proceeds from the surface in the specimen interiors. These phenomena are attributed to grain boundary cracking which occurs as a result of the transformation. The time-transformation isotherms at 353 K and at room temperature can be expressed by the Johnson-Mehl equation $f = 1 - \exp(-bt \exp n)$, and the same n value of 0.7 was obtained irrespective of grain size and of environment.

Author

A92-11992

HIGH-TEMPERATURE STRESS RUPTURE TESTS FOR SINTERED SILICON NITRIDE

A. OKADA, M. MATSUNAGA, and N. HIROSAKI (Nissan Motor Co., Ltd., Yokosuka, Japan) *Journal of Materials Science Letters* (ISSN 0261-8028), vol. 10, Oct. 15, 1991, p. 1202-1204. refs

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Flexural strength rupture tests have been conducted for sintered Si₃N₄ at 1000 C in a nitrogen atmosphere to preclude both active and passive oxidation. A region of subcritical crack growth was observed along the grain boundary at the failure origins; creep deformation was also observed for specimens sustained for a long period under static loads. The principal mechanism governing

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creep deformation and subcritical crack growth of sintered Si₃N₄ at elevated temperature appears to be grain boundary sliding due to the softening of the glassy phase at the grain boundary. O.C.

A92-12381

SYNTHESIS OF MULLITE WHISKERS AND THEIR APPLICATION IN COMPOSITES

KIYOSHI OKADA and NOZOMU OTUSKA (Tokyo Institute of Technology, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 74, Oct. 1991, p. 2414-2418. refs
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Mullite whiskers were synthesized by a vapor-solid reaction. Mullite composition xerogels were fired at 900 to 1600 C with AlF₃ in an airtight container. An average whisker increased in length from 7 microns at 1100 C to 10 microns at 1600 C, whereas an average whisker decreased in aspect ratio from 25 to 10 with increased firing temperatures. The whiskers elongated to the c-axis and the side planes were the 110-plane oriented. A clear lattice image corresponding to (110) lattice spacing up to the edges of the whiskers was observed with high-resolution electron microscopy, and no droplet was observed on the tips of the whiskers. The chemical composition of the whiskers synthesized below 1100 C showed an apparent Al₂O₃-rich composition of about 72 mol pct. Composites reinforced by 15 vol pct of mullite whiskers in the matrix of 75 vol pct mullite/25 Y-TZP enhanced the fracture toughness compared with those materials without mullite whiskers. Author

A92-15499

FRACTURE STRENGTH PROPERTIES OF SINTERED-Si₃N₄ AT HIGH TEMPERATURES AND UNIFIED ESTIMATION METHOD WITH CONSIDERING TEMPERATURE-DEPENDENCE

NAGATOSHI OKABE and HIDEYUKI HIRATA (Toshiba Corp., Heavy Apparatus Engineering Laboratory, Yokohama, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 40, Oct. 1991, p. 1341-1347. In Japanese. refs
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The temperature dependence of the fracture strength of sintered Si₃N₄, which is relevant to gas turbine technology, was investigated from 1000 C to 1300 C. It is found that the normalized fracture strength data can be commonly expressed by a formula with two statistical parameters: the crack growth property parameter *n* and the activation energy. The value of *n* decreases with increasing temperature. The temperature dependence of the fracture strength can be well expressed by Arrhenius plots. The strength follows the Weibull distribution with two parameters so that fracture strength and fracture life at an arbitrary temperature from 1000 to 1300 C can be probabilistically estimated if the effective volume and effective hold time are given. C.D.

A92-17404

PREPARATION AND PROPERTIES OF LEAD ZIRCONATE-TITANATE PIEZOELECTRIC CERAMICS USING ULTRAFINE PARTICLES

NOBORU ICHINOSE and MASAHICO KIMURA (Waseda University, Tokyo, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2220-2223. refs
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Results are presented on measurements of electrical and mechanical properties of ceramics prepared from ultrafine particles obtained in the system PbTiO₃-PbZrO₃-Pb(Ni_{1/3}Nb_{2/3})O₃ by a ball milling method using zirconia balls of 0.3, 3, and 9 mm diameter. In the case of 0.3 mm balls, ultrafine powder on the order of 0.1 micron was obtained in a relatively short time. It is shown that the properties of sintered samples are dependent on the grain size. Smaller grain size resulted in higher flexural strength; on the other hand, the maximum electrical properties were exhibited at grain size of about 2.5 microns. I.S.

A92-18644

HIGH-TEMPERATURE DEFORMATION AND GRAIN GROWTH IN FINE-GRAINED ZIRCONIA

YU-ICHI YOSHIZAWA and TAKETO SAKUMA (Tokyo, University, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 847-849, 851-854. refs
(Contract MOESC-02229206; MOESC-02750545)
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The effects of grain size on high-temperature deformation and strain-induced grain growth were examined in fine-grained tetragonal zirconia polycrystals (TZP) at 1400 C. The fine-grained TZP, with a grain size less than about 1 micron, were superplastically deformed at this temperature. Superplastic deformation was characterized by the small work hardening during the deformation. A small work hardening in superplastic deformation was principally caused by the stress increase due to grain growth. The grain growth during deformation consisted of the static grain growth and the strain-induced one. The strain-induced grain growth was found to be proportional to strain. Author

A92-18646

TIME-DEPENDENT MECHANICAL BEHAVIOUR OF ALUMINA CERAMICS

A. T. YOKOBORI, JR. (Tohoku University, Sendai, Japan), T. ADACHI (Ishinomaki Senshu University, Japan), and T. YOKOBORI (Teikyo University, Utsunomiya, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 863-870. refs
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The strength of ceramics has been thought to be controlled by a stress corrosion mechanism, but experimental results which do not obey this mechanism have been reported recently. In this paper, dynamic fatigue test, static fatigue test, stress relaxation test, and measurement of internal friction were carried out for the smooth specimens of alumina ceramics. Furthermore, the dynamic fatigue characteristics were simulated by using a viscoelastic model. From these results, it was shown that alumina ceramics have viscoelastic properties and their mechanical properties were also affected by this mechanism. In addition, the effects of added components and grain size on dynamic fatigue are discussed. Author

A92-18648

EFFECT OF COOLING CONFIGURATION ON THERMAL SHOCK FRACTURE TOUGHNESS OF SiC

Y. KANTO and H. HOMMA (Toyoashi University of Technology, Japan) (International Conference on Advanced Materials Mechanical Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 893-899, 901. refs
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A method for measuring thermal-shock-fracture toughness of SiC was established. A 20-mm wide, 50-mm-long, and 6-mm thick specimen having an edge crack in the central section was heated up to a given temperature and was quenched in such a way that the crack mouth side of the specimen was sunk to a depth of 1 mm from the water surface. Two cooling methods were used, and the time histories of the stress intensity factors for various values of *a/W* were analyzed using the finite element method. The results were used to determine the appropriate conditions of *a/W* and the method of cooling. I.S.

A92-19718

CRACK PROPAGATION BEHAVIOR OF Si₃N₄ UNDER CYCLIC LOADS - INFLUENCE OF DIFFERENCE IN MATERIALS

H. KISHIMOTO, A. UENO (Toyota Technological Institute, Nagoya, Japan), and H. KAWAMOTO (Toyota Motor Corp., Japan) IN:

Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 727-732. refs
Copyright

Crack-propagation behavior under cyclic load was investigated on two kinds of sintered silicon nitride. The main results are as follows. The crack-propagation rate was accelerated by cycling the load. As the stress ratio decreased or the test frequency increased, the crack propagation rate increased. In case of a specimen with high fracture toughness, the crack propagation rate was small as compared with that of another specimen with low fracture toughness. By measuring the crack-opening displacement, crack closure was observed. Close agreement between the opening displacement of 1 to 1.5 micron and the diameter of the columnar silicon nitride crystals existed. The crack closure was induced by the debris between the crack surfaces. Author

A92-19720
CYCLIC FATIGUE DAMAGE AND MICROSTRUCTURE OF CERAMIC MATERIALS

S. HORIBE (National Research Institute for Metals, Tsukuba, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 753-758. refs
Copyright

In order to elucidate the fatigue mechanism of brittle ceramics, cyclic crack behavior was investigated for various types of silicon nitride and silicon carbide with special attention to the effects of microstructure. The experimental results reveal that the intergranular cracking characteristic is requisite for the cyclic fatigue damage in brittle ceramics, and a mechanism for crack resistance and reactivation is taken to be reasonable for the cyclic fatigue of ceramic materials. Author

A92-19721
AN EVALUATION OF THERMAL SHOCK RESISTANCE IN STRUCTURAL CERAMICS UNDER REPEATED THERMAL SHOCK CONDITIONS

Y. KIMURA (Kogakuin University, Tokyo, Japan) and S. ANIYAMA (Toyota Motor Corp., Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 769-774. refs
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A method for evaluating the resisting strength of various ceramic materials under repeated thermal shock conditions is advocated, and some trials for applying this method to the investigation of the real thermal shock resistances of several structural ceramics are conducted. Minimum thermal-shock conditions required for the onset of subcritical crack propagation were investigated for tetragonal zirconia polycrystalline, Si₃N₄ and SiC, by employing a Vickers indented square cross-sectional bar specimen. Then, through estimating the intensity of thermal shock by $K_{sub I}$, the resistance of materials under repeated thermal-shock conditions was evaluated by the amount of subcritical crack growth per each thermal-shock cycle. Author

A92-19724
THE EFFECTS OF TEMPERATURE AND HUMIDITY ON DYNAMIC AND STATIC FATIGUE IN PMMA

T. NATSUI, Y. HIGO, S. NUNOMURA (Tokyo Institute of Technology, Japan), and J. MATSUOKA (Nissan Motor Co., Ltd., Technical Center, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 807-812. refs
Copyright

A92-21095
MICROSTRUCTURAL DEVELOPMENT DURING GAS-PRESSURE SINTERING OF ALPHA-SILICON NITRIDE

MAMORU MITOMO (National Institute for Research in Inorganic Materials, Tsukuba, Japan) and SATOSHI UENOSONO (Kawasaki Steel Corp., High-Technology Research Institute, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, Jan. 1992, p. 103-108. refs

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Diameter and aspect ratio measurements were conducted on hexagonal grains revealed on polished and etched surfaces of gas-pressure sintered alpha-Si₃N₄ samples whose densification had been conducted at 1850-2000 C in 980 kPa-pressure N₂. The aspect ratio of large and elongated grains was greater than for the average of all grains. The fracture-toughness of these materials was related to the diameter of the large grains; crack-bridging was the primary toughening mechanism. O.C.

A92-21097
DENSIFICATION AND MICROSTRUCTURAL DEVELOPMENT OF SILICON NITRIDE-SILICA DURING HOT ISOSTATIC PRESSING

JIANREN ZENG, ISAO TANAKA, YOSHINARI MIYAMOTO, KOICHI NIIHARA (Osaka University, Ibaraki, Japan), and OSAMU YAMADA (Osaka Industrial University, Daito, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, Jan. 1992, p. 148-152. refs

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A92-22340
A POLYMER GEL WITH ELECTRICALLY DRIVEN MOTILITY

YOSHIHITO OSADA, HIDENORI OKUZAKI, and HIROFUMI HORI (Ibaraki University, Mito, Japan) Nature (ISSN 0028-0836), vol. 355, Jan. 16, 1992, p. 242-244. Research supported by Science and Technology Agency of Japan. refs

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A chemomechanical system based on a synthetic polymer gel is described which can serve as an actuator or an 'artificial muscle'. The gel network is anionic, and positively charged surfactant molecules can therefore bind to its surface, inducing local shrinkage by decreasing the difference in osmotic pressure between the gel interior and the solution outside. Using an electric field to direct surfactant binding selectively to one side of the gel can induce contraction and curvature of a strip of gel. Reversing the direction of the field causes contraction of the opposite side, and when the gel is suspended in solution from a ratchet mechanism, it can be made to move with a wormlike motion at a velocity of up to 25 cm/min. C.D.

A92-22734
PREPARATION OF SPHERICAL CERIA-DOPED TETRAGONAL ZIRCONIA BY THE SPRAY-PYROLYSIS METHOD

T. YOSHIOKA, K. DOSAKA, T. SATO, A. OKUWAKI, S. TANNO, and T. MIURA (Tohoku University, Sendai, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, Jan. 1, 1992, p. 51-55. refs

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It has been established that CeO₂-doped TZP exhibits excellent fracture toughness and resistance to tetragonal-to-monoclinic phase transformation by low-temperature aging, albeit in association with only modest sinterability and fracture strength. Improvements in mechanical properties and sinterability of CeO₂-TZP are presently sought through the preparation of powders via spray pyrolysis, using a twin-fluid atomization technique. The powders are characterized by XRD, simultaneous thermogravimetry, and DTA. O.C.

A92-22920
PROCESS ZONE SIZE FAILURE CRITERION AND PROBABILISTIC FRACTURE ASSESSMENT CURVES FOR CERAMICS

K. ANDO, B. A. KIM, M. IWASA, and N. OGURA (Yokohama National University, Japan) Fatigue and Fracture of Engineering

27 NONMETALLIC MATERIALS

Materials and Structures (ISSN 8756-758X), vol. 15, Feb. 1992, p. 139-149. refs

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Data of fracture toughness and fracture stress of ceramics, generally show considerable size effects and scatter. This presents problems for the integrity of structural ceramics. Fracture mechanics tests results on Si_3N_4 and Al_2O_3 reveal a sensitivity to crack size and the necessary to invoke probabilistic concepts to evaluate their integrity. A new failure criterion is proposed, based on the existence of a crack-tip process zone. A probabilistic failure assessment curve is also proposed to quantitatively evaluate reliability. Author

A92-23138

THERMODYNAMICAL STABILITY BETWEEN TiC AND Ti

YOSHIKAZU SHINOHARA, YOSHIO IMAI, SUSUMU IKENO, and ICHIRO SHIOTA (National Research Institute for Metals, Tokyo, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 379-385. Research sponsored by Science and Technology Agency. refs

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The effect of the crystal structure on the thermodynamic stability of TiC films deposited onto a titanium substrate has been investigated. TiC films were deposited by the HCD-type PVD method. A new phase of $\text{TiC}(1-x)$ was formed at the interface between TiC and Ti after heat treatment independently of the crystal structure of TiC. The thickness of $\text{TiC}(1-x)$ increased as the heat treatment time. The increased rate of the new phase was small when the crystal size of TiC was small. The smaller crystal size of TiC with random orientation is shown to be thermodynamically stable. Author

A92-23139

OXIDATION BEHAVIOR OF MESOPHASE PITCH BASED HIGH MODULUS CARBON FIBERS

H. KIMURA and K. KUBOMURA (Nippon Steel Corp., Kawasaki, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 387-394. refs

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Mesophase pitch based carbon fibers of three different tensile moduli were electrochemically oxidized in sodium hydroxide, nitric acid and sulfuric acid solutions. The higher tensile modulus fibers were less oxidized on the surface compared with the lower modulus fibers because they were more graphitized. Further, the surface graphite crystalline was disturbed by the oxidization and the rates of surface oxygen concentration increase were different in different solutions. The interfacial shear strength between oxidized carbon fibers and a matrix was measured by the single filament critical length method. With increasing oxygen concentration the interfacial shear strength increased. Author

A92-23140

THE MECHANICAL PROPERTIES AND THE STRUCTURES OF CVD-COATED SiC FIBRES

J. X. LI, A. KIMURA, Y. MATSUO, and S. KIMURA (Tokyo Institute of Technology, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 395-401. refs

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The SiC coating on Nicalon fiber was deposited by the low-pressure chemical vapor deposition. The mechanical properties and the structures of coated and uncoated fibers were studied. The results showed that thermal degradation of a fiber could not be avoided, since a lot of large pits formed on the fiber surface during the heating stage of the CVD processes. The SiC coating can act as an effective fiber-coating interfacial diffusion barrier in coated fiber, resist the gas evolution from the fiber surface, and

prevent decomposition of Nicalon fiber at elevated temperature. SiC-coated fiber with excellent high temperature mechanical properties is expected to be used in ceramic matrix composites.

Author

A92-24592

SOME PROBLEMS IN APPLICATION OF THREE-PARAMETER WEIBULL DISTRIBUTIONS TO RELIABILITY EVALUATION OF CERAMICS

MASAHIRO ICHIKAWA (University of Electro-Communications, Chofu, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, Jan. 1992, p. 12-21. refs

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A92-24595

ESTIMATION OF FRACTURE CONDITIONS OF CERAMICS BY THERMAL SHOCK WITH LASER BEAMS BASED ON THE MAXIMUM COMPRESSIVE STRESS CRITERION

SHIGERU AKIYAMA (Ship Research Institute, Mitaka, Japan) and SHIGEYASU AMADA (Gumma University, Kiryu, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, Jan. 1992, p. 91-94. refs

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A92-24596

PROPOSAL ON THE METHOD OF FIXING PROOF STRENGTH FOR CERAMIC COMPONENTS

HIROSHI MIYATA (Hitachi, Ltd., Research Laboratory, Japan), TAKASHI MACHIDA (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Japan), and SHIGERU SHIDA (Hitachi Institute of Technology, Tokyo, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, Jan. 1992, p. 123-131. refs

Copyright

A method is proposed for determining proof strength of ceramic components based on fracture behavior. The strength for short time fracture mainly depends on the sizes of initial defects in the ceramics, but it cannot be uniquely determined by the constant fracture toughness criterion which is well known for applicability to brittle materials. For static fatigue behavior, a static fatigue limit below which cracks are arrested is observed. Both short-time fracture strength and static fatigue limit are shown to have nonlinear relationships to defect size. By considering these dependences, the method gives proof strength which is effective in designing ceramic components. Author

A92-26698

CRAZING IN SEMICRYSTALLINE THERMOPLASTICS

I. NARISAWA and M. ISHIKAWA (Yamagata University, Yonezawa, Japan) IN: Crazing in polymers. Vol. 2. Berlin and New York, Springer-Verlag, 1990, p. 353-391. refs

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Crazing in PP, PE, POM, PA 6, PA 66, PBT, and PEEK has been described in relation to their deformation and fracture behavior. It has been demonstrated that the nature of the damage zone ahead of a notch is governed by the type of stress field: plane stress and plane strain. Plane strain conditions favored by thick sections with notches cause a dilatational stress concentration at the tip of the local plastic zone ahead of the notch and lead to the nucleation of numerous crazes above a certain critical level of dilatational stress. The individual crazes grow along a plane normal to the major tensile stress and almost ignore the spherulitic structure. The effect of a number of variables such as ambient temperature, pressure, thermal history, and molecular weight on crazing are examined in detail. Author

A92-26711

IN-SITU FORMATION OF SiC AND SiC-C BLOCKED SOLIDS BY SELF-COMBUSTION SYNTHESIS

S. IKEDA, K. URABE, MITSUE KOIZUMI (Ryukoku University, Kyoto, Japan), and H. IZAWA (Osaka Cement Co., Ltd., Research Laboratory, Japan) IN: Combustion and plasma synthesis of

high-temperature materials. New York, VCH Publishers, 1990, p. 151-156. refs

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A macroscopically homogeneous SiC-C solid block was obtained by the SHS reaction of a previously shaped carbon material and molten silicon. The product contained about 30 mol pct of beta-SiC. The shape and the size of the composite were almost the same as those of the starting carbon material. Improvements in the mechanical properties were attributable to the formation of SiC by the SHS reaction. Author

A92-26712

SIMULTANEOUS SYNTHESIS AND DENSIFICATION OF CERAMIC COMPONENTS UNDER GAS PRESSURE BY SHS

YOSHINARI MIYAMOTO (Osaka University, Ibaraki, Japan) and MITSUE KOIZUMI (Ryukoku University, Kyoto, Japan) IN: Combustion and plasma synthesis of high-temperature materials. New York, VCH Publishers, 1990, p. 163-169. refs

Copyright

Gas-pressure combustion sintering is a new reaction-sintering process that synthesizes and densifies ceramics simultaneously and rapidly under isostatic pressure. By this method, the dense ceramics of TiB₂ (TiB₄, TiB) and TiC(x) (x = 0.5-0.8) and the composites of TiC + Ni (10 wt percent or more) have been fabricated from their elemental powders under Ar-gas pressures below 100 MPa. This process has potential not only for the mass production of near-net shape components, but also for the production of a variety of new material complexes in ceramic-ceramic and ceramic-metal systems. Author

A92-28812

SINTERING OF CERIA-DOPED TETRAGONAL ZIRCONIA CRYSTALLIZED IN ORGANIC SOLVENTS, WATER, AND AIR

TSUGIO SATO, KENJI DOSAKA, TOSHIKI YOSHIOKA, AKUTSUGU OKUWAKI, KAZUO TORII, and YOSHIRO ONODERA (Tohoku University, Sendai, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, March 1992, p. 552-556. refs

(Contract MOESC-03403015)

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Amorphous CeO₂-ZrO₂ gels were prepared by coprecipitation in ammonia solutions. The onset of crystallization of the gels, from calcining in air, was 420 C, while 200 to 250 C in the presence of water and organic solvents such as methanol and ethanol. The sintering behaviors of CeO₂-ZrO₂ powders were sensitive to the crystallizing conditions, since hard agglomerates formed when the precipitated gels were crystallized by normal calcination in air, whereas soft agglomerates formed when they were crystallized in water or organic solvents. CeO₂-ZrO₂ powders crystallized in methanol and water at 250 C were sintered to full theoretical density at 1150 and 1400 C, respectively, whereas that crystallized by calcination in air at 450 C was sintered to only 95.2 percent of theoretical density, even at 1500 C. Author

A92-28978

EFFECTS OF ELECTROLYTE ON THE STRUCTURE OF PYROLYTIC GRAPHITE SURFACES IN ANODIC OXIDATION

MASANORI NAKAHARA and KAZUHARU SHIMIZU (Toray Industries, Inc., Otsu, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, March 1, 1992, p. 1207-1211. refs

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Anodic oxidation effects on the structure of the basal and edge surfaces of pyrolytic graphite in alkaline electrolytes have been studied. Laser Raman spectroscopy, a gas-phase chemical modification method, coupled with X-ray photoelectron spectroscopy and secondary ion-mass spectroscopy techniques, were used. It was found that anodic oxidation in alkaline electrolytes has a wider permitted range of treatment, in which hydroxyl groups can be added without destroying the edge surface structure, than that found in acid electrolytes. On the other hand, the number of hydroxyl groups added by treating with alkaline electrolytes is smaller than that with acid electrolytes. At a higher treatment level with acid electrolytes, oxidation occurs, even to a depth of 40 nm from the edge surface, whereas with alkaline electrolytes,

oxidation occurs only at the surface. On the basis of these results, the effects of electrolytes on the adhesion between carbon fibers and epoxy resin matrix are discussed. Author

A92-29413

INFLUENCES OF DEFECTS UPON THE FATIGUE STRENGTH OF Si₃N₄ CERAMICS

HIROSHI HOHJO, KATSUSHI SARUKI, and AKIRA YAMADA (Toyota Central Research and Development Laboratory, Inc., Aichi, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, Jan. 1992, p. 61-67. In Japanese. refs

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Rotating bending fatigue tests were carried out on two lots of Si₃N₄ ceramics, and the effects of defects and density on the fatigue strength were investigated. Bulk densities of lots A and B were 3.02 g/cu cm and 3.16 g/cu cm, respectively. Average static bending strength of lot B was about 20 percent higher than that of lot A due to differences in defect distribution and fracture toughness. However, the two lots scarcely differed in rotating bending fatigue strength, due to the fact that fatigue strength depends largely on the size and kind of defects. Fatigue strength predictions are made based on fatigue data in the case when fracture origin is the largest pore defect. C.D.

A92-30485

SILICON NITRIDE - 1

SHIGEYUKI SOMIYA, ED. (Nishi-Tokyo University, Japan), MAMORU MITOMO, ED. (National Institute for Research in Inorganic Materials, Ibaraki, Japan), and MASAHIRO YOSHIMURA, ED. (Tokyo Institute of Technology, Yokohama, Japan) London and New York, Elsevier Applied Science (Ceramic Research and Development in Japan. Vol. 1), 1990, 177 p. Translation. No individual items are abstracted in this volume. (ISBN 1-85166-329-0) Copyright

The present conference on silicon nitride ceramics encompasses the properties, phase relations, and thermodynamics of the materials, the fabrication of particular versions of these ceramics, the synthetic processes of silicon nitride material powders, silica nitriding, and the properties and applications of silicon nitride products. Specific issues addressed include sintering aids of silicon nitride, the properties of the raw material powders, slurry and molding characteristics, a comparison of Si₃N₄ powders synthesized by the metallic silicon method and the silicon chloride ammonium method, and an alpha-Si₃N₄ powder produced by nitriding silica via carbothermal reduction. Also addressed are the imide decomposition method for powder production, the injection molding of silicon nitride powders, the influence of Si₃N₄ powder characteristics on sintering behavior, the joining of Si₃N₄ with Si₃N₄ and metals, and the properties and applications of Si₃N₄ whiskers. C.C.S.

A92-32022

FATIGUE CRACK INITIATION AND PROPAGATION IN SMOOTH SPECIMENS OF POLYCARBONATE

HIIZU HYAKUTAKE and TOSHIHIRO YAMAMOTO Japan Society of Mechanical Engineers, Transactions A (ISSN 0387-5008), vol. 56, Sept. 1990, p. 1925-1930. In Japanese. refs

Fatigue tests of a push-pull loading were carried out on the smooth specimens of polycarbonate at the speed of 2 Hz at room temperature. The role of very small inclusions and shear bands in the initiation and growth of fatigue crack on the surface of specimen was investigated. This is accomplished by careful successive observations by using the replica of cellulose methyl ether. It was found that the initiation of the surface crack appeared from the fine inclusions near the surface of specimens at 20-30 percent of the fatigue life, and that the surface crack from these inclusions was hindered by the shear bands that formed at the ends. The final length of surface crack is strongly influenced by the stress amplitude. The characteristic behaviors of the crack initiation and growth on the surface of the smooth specimens of polycarbonate were discussed in terms of the mechanical properties and yield behavior of the material. Author

A92-32403

FRICTION AND DAMAGE OF COATINGS FORMED BY SPUTTERING POLYTETRAFLUOROETHYLENE AND POLYIMIDE

YOSHINORI YAMADA, KYUICHIYUO TANAKA, and KIYOSHI SAITO (Kanazawa University, Japan) IN: Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 618-628. refs
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The tribological performance, friction, and wear properties of coating films deposited by sputtering PTFE and PI are investigated. A sapphire ball 5 mm in diameter was slid on the films at a slow speed. The friction coefficients of these films did not depend on the load and film thickness. When the sliding was repeated on the same track, the friction of PTFE films increased as the number of passes increased. A large fluctuation in the friction was observed as the film wore away from the track. With PI films the friction coefficient was almost constant during the experiment. A pin-on-disk apparatus was used to estimate the life of the films as the number of passes when the friction coefficient exceeded 0.5. Although almost all films were worn away from the track in relatively small passes, thin films left on the track were effective in suppressing the friction increase. PI film exhibited a much longer life than PTFE, although PI film exhibited a brittle fracture in contrast to PTFE film. Heat treating the films effectively increased the PTFE film life but decreased the PI film life. P.D.

A92-32802

TENSILE FRACTURE SURFACE ANALYSIS FOR BORON FIBERS

CHITOSHI MASUDA, YOSHIHISA TANAKA (National Research Institute for Metals, Tokyo, Japan), and TOSHIHIKO KURIYAMA (Musashi Institute of Technology, Tokyo, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 29-J-1 to 29-J-12. refs

In order to discuss the relationship between the fracture strength and defect sizes in relation to the stress intensity factor, a tensile test was performed and fracture surfaces were examined by SEM for two kinds of boron fibers fabricated by the CVD method. The Weibull plots of tensile strength for boron fiber were divided into three regions, that is, the lowest-strength one, medium-strength one, and highest-strength one. Fractography revealed that in the lowest-strength region the defect sizes were very large, while in the highest region the defect could hardly be observed. The defect sizes were linearly related to the fracture strength which could be evaluated by the fracture mechanics. The critical stress intensity factor for surface defects was about twice larger than that for inner defect observed near core of the tungsten fiber. This means that the difference between residual stress near the fiber surface and near core tungsten fiber is about 1.5 GPa. Author

A92-33378

EVALUATION OF SLOW CRACK GROWTH RESISTANCE IN CERAMICS FOR HIGH-TEMPERATURE APPLICATIONS

ISAO TANAKA and GIUSEPPE PEZZOTTI (Osaka University, Ibaraki, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, April 1992, p. 772-777. refs
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The slow (subcritical) crack growth (SCG) resistance of Si₃N₄ and SiC ceramics has been evaluated by a stepwise-loading test on bending bars precracked by Vickers indentation. Three highly refractory materials were selected for the evaluation: (1) high-purity Si₃N₄ sintered by hot isostatic pressing (HIP) without additives and (2,3) alpha- and beta-SiC pressureless sintered with B and C addition. Under the hypothesis of linear elastic behavior at high temperature, which was found satisfied in the present materials, the SCG resistance was expressed in terms of initial stress intensity factor critical for SCG failure within a predetermined lifetime. The

present method was found useful in shortening the testing time and consistent with other traditional fatigue tests (e.g., static-fatigue test). It is recommended as a screening test for materials under research and development. Among the materials tested in the present study, the highest SCG resistance up to 1440 C was found in the high-purity Si₃N₄ without additives. Author

A92-33528

EFFECT OF THE AMOUNT OF Y₂O₃-Nd₂O₃ ON THE SINTERING AND HIGH-TEMPERATURE PROPERTIES OF SILICON NITRIDE

NAOTO HIROSAKI (Nissan Motor Co., Ltd., Yokosuka, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, Feb. 1992, p. 207-211. In Japanese. refs
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The effect of the amount of added oxide on the gas-pressure sintering behavior of silicon nitride and the high-temperature properties (oxidation and strength resistance) of the sintered materials is investigated. Composition analysis of the sintered samples indicated that SN1 densified through a small amount of SiO₂-rich liquid phase, while SN10 densified by a large amount of additive oxide-rich liquid phase. SN1 had higher strength than SN10 at higher temperatures due to its smaller amounts of glassy phase. R.E.P.

A92-33530

STATIC AND CYCLIC FATIGUE TESTS OF SINTERED Si₃N₄ WITH SMALL SEMI-ELLIPTICAL SURFACE CRACK

AKIRA UENO, HIDEHIRO KISHIMOTO (Toyota Technological Institute, Nagoya, Japan), and HIROSHI KAWAMOTO (Toyota Motor Co., Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, Feb. 1992, p. 253-259. In Japanese. refs

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Static and cyclic fatigue tests on sintered Si₃N₄ with a small crack are conducted to clarify the crack size effect on fatigue strength. The small semielliptical surface crack was introduced by Knoop indentation. The fatigue life determined in this study is compared with the estimated life derived from propagation data of a CT specimen. It is concluded that the fatigue life observed in this investigation is longer than the estimated fatigue life. R.E.P.

A92-34203

SYNTHESIS OF ALPHA-ALUMINA FIBRE FROM MODIFIED ALUMINUM ALKOXIDE PRECURSOR

T. YOGO and H. IWAHARA (Nagoya University, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, March 15, 1992, p. 1499-1504. refs
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Polycrystalline alumina fiber was successfully synthesized by pyrolysis of a preceramic fiber formed from aluminum compounds with alkoxy and chelate ligands. A mixture of ethyl 3-oxobutanoatodisopropoxyaluminum (EOPA) and tri-sec-butoxy-aluminum (SBA) was reached with glacial acetic acid yielding a polymeric product. The IR absorptions at 630 and 700/cm due to the Al-O bond changed from sharp to broad bands by treatment with acetic acid. The Al-27 resonance at 35 ppm increased in intensity when EOPA-SBA (7/3) was treated with 30 mol pct acetic acid. An increase in the EOPA to SBA ratio 5/5 to 9/1 also raised the intensity of the signal at 35 ppm. The viscosity of the polymeric product increased in intensity as the amount of acetic acid increased. The viscosity of precursor increased with increasing the ratio of EOPA to SBA, and decreased with increasing measurement temperature from 45 to 75 C. The precursor polymer pyrolysed at 500 C in air was amorphous to X-rays, and crystallized in gamma-alumina at 840 C. The precursor fibers were pyrolyzed to yield fine-grained fibers of alpha-alumina at 1200 C for 1 h. Author

A92-35617

LUBRICANT CHARACTERISTICS OF THE SOLID LUBRICANT EXPOSED TO AOX BEAMS

MASAMORI ARITA and Y. YOSHIDA (Nissan Co., Ltd., Tokyo,

Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 29, 30. In Japanese. refs

Solid lubricant consisting of molybdenum sulfides and lead capsules are tested. The test method and results are given and friction coefficients and atomic concentrations are presented. The reliability of the solid lubricant on exposure to AOx beams is reported. Y.P.Q.

A92-36296

STRUCTURE AND PROPERTIES OF MESOPHASE PITCH CARBON FIBRE WITH A SKIN-CORE STRUCTURE CARBONIZED UNDER STRAIN

I. MOCHIDA, S. M. ZENG, Y. KORAI (Kyushu University, Kasuga, Japan), T. HINO, and H. TOSHIMA (Tonen Co., Ltd., Corporate Research and Development Laboratory, Iruma, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 7, April 1, 1992, p. 1960-1968. refs

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Coal tar mesophase pitch fibers stabilized at 270 C to different extents were carbonized under strain by the constant load or constant length, using different heating rates, and further graphitized at 2500 C. Shallow and moderate stabilization provided a skin-core structure in the resultant fibers which exhibited higher orientation, tensile modulus, and better graphitizability after calcination at 1300 C and graphitization at 2500 C than deep stabilization. The tensile strength and modulus of the graphitized fiber was significantly improved through the strained carbonization when the stabilization was performed to a moderate extent. The strain tended to give an onion-like alignment in the fiber to improve the preferred orientation of carbon planes. Larger load and more rapid heating during carbonization modified the structure and properties of resultant fibers through a significant longitudinal elongation. The stabilization extent of pitch fibers governs the mobility or fusibility of mesogen molecules at the carbonization which allows their better alignment by the strain. Author

A92-37095

PREFERRED ORIENTATION OF PITCH PRECURSOR FIBERS AND CARBON FIBERS PREPARED FROM ISOTROPIC PITCH

T. HAMADA (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan), M. FURUYAMA (Three-D Composites Research Corp., Tsukuba, Japan), T. TOMIOKA (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan), and M. ENDO (Shinshu University, Nagano, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, no. 5, May 1992, p. 1178-1188. refs

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The inhomogeneity of Lc(002) and the correlation between Lc(002) and the degree of preferred orientation are studied for carbon fibers and pitch precursor fibers derived from an isotropic pitch. The pitch precursor fibers exhibit a preferred orientation of condensed aromatic molecules along the fiber axis. The degree of preferred orientation becomes higher as the filament diameter is reduced and the pitch viscosity during spinning is elevated. No preferred orientation is observed for fibers with very large diameters. V.L.

A92-39624

THERMAL STABILITY OF THE LOW OXYGEN SILICON CARBIDE FIBERS DERIVED FROM POLYCARBOSILANE

M. TAKEDA, Y. IMAI, H. ICHIKAWA, T. ISHIKAWA (Nippon Carbon Co., Ltd., Yokohama, Japan), . KASAI, T. SUGUCHI (Japan Atomic Energy Research Institute, Takasaki), and K. OKAMURA (Osaka Prefecture University, Sakai, Japan) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 7-8, July-Aug. 1992, p. 209-217. refs

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SiC fibers with excellent thermal stability have been developed by means of reducing their oxygen content. Polycarbosilane fibers were cured by electron beam irradiation in a stream of helium and were pyrolyzed in an inert atmosphere. These SiC fibers were

continuous, in multifilament form, consisting of Si-1.3C-0.02O by atomic ratio. They had a high tensile strength and elastic modulus of 2.8 GPa and 270 GPa, respectively. At high temperature, the low oxygen SiC fibers were observed to undergo no chemical decompositions and retained good tensile properties. The mechanical properties of the SiC composites reinforced by these SiC fibers were also investigated. Author

A92-39845

MEASUREMENT OF THE IMPACT FRACTURE TOUGHNESS OF CERAMIC MATERIALS AT ELEVATED TEMPERATURES

MASARU SAKATA, SHIGERU AOKI, and KIKUO KISHIMOTO (Tokyo Institute of Technology, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 65-82. refs

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An instrumentation system is developed for measuring the impact fracture toughness of ceramic materials at temperatures up to 1200 C. The specimen is of Charpy type, composed of SiC, PSZ or sialon, and contains a crack or a 0.2 mm deep notch. Each specimen is suspended in an IR image furnace by two thin ceramic threads cemented on its end faces. A simple formula is used to determine the dynamic stress intensity factor from the measured impact force. The impact fracture toughness values determined by the impact test are then compared with the results of quasi-static tests. R.E.P.

A92-41776

SYMPOSIUM ON ADHESION AND ADHESIVES, 29TH, NAGOYA, JAPAN, JUNE 20, 21, 1991, PROCEEDINGS

Symposium sponsored by Adhesion Society of Japan. Osaka, Adhesion Society of Japan, 1991, 203 p. In Japanese. For individual items see A92-41777 to A92-41787.

Various papers on adhesion and adhesives are presented. Individual topics discussed include: surface modification of epoxy resins by the introduction of low surface energy segments, effects of the resin structure on internal stress generated in the cured epoxide resins, toughening of epoxy resins by the addition of polyetherpolyurethanes, fracture behavior of thermoplastic modified epoxy resin, engineering and technology of Japanese aircraft and spacecraft, interlaminar shear strength of fiber reinforced plastics. Also addressed are: interlaminar fracture of CFRP laminates, relationship between surface energy of polymer composite and adhesive strength, stress analysis of variable adhesive thickness and variable adhesive thickness joints, fractured behaviors of adhesively bonded joint and spot welded joint in sheet metal joining, quantitative prediction of bondline durability. C.D.

A92-41777

SURFACE MODIFICATION OF EPOXY RESINS BY THE INTRODUCTION OF LOW SURFACE ENERGY SEGMENTS

TOMOYUKI KASEMURA, SHINJI KAWAI, and HIDEAKI UOZUMI (Gifu University, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 1-4. In Japanese.

The surface characteristics of epoxy resin and its chemical reactions are presented. Test materials, such as epikote 828 and bis para-aminocyclohexymethane are given and test procedures, measurements, and results are discussed. The surface modification of silicon diamines is reported. Y.P.Q.

A92-41778

EFFECTS OF THE RESIN STRUCTURE ON INTERNAL STRESS GENERATED IN CURED EPOXY RESINS

MITSUKAZU OCHI, TAKUYA SHIRAIISHI, and EIJI MOTOBE (Kansai University, Suita, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 5-8. In Japanese. refs

The chemical structure of epoxy resins and the curing agent is presented. Internal stress of cured epoxy resins having different skeleton structure and dynamic mechanical properties, and

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annealed and quenched epoxy resins are described. The linear expansion coefficient of cured epoxy resins is analyzed. Y.P.Q.

A92-41779

TOUGHENING OF EPOXY RESINS BY THE ADDITION OF POLYETHER POLYURETHANES

EISUKE YAMADA, SHINJI INAGAKI, HIROSHI OKAMOTO, JUNJI FURUKAWA (Aichi Institute of Technology, Japan), MASA HARU MIURA, NOBUYA SATO, and MAKOTO KOBAYASHI (IIDA Industry Co., Ltd., Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 9-12. In Japanese.

Applications of epoxy resins are outlined. An experiment on the toughening of the epoxy resins by adding polyether polyurethanes is presented. The effect of PPU-PU content on epoxy resins is assessed and the temperature dependence of the shear modulus is analyzed. Y.P.Q.

A92-41780

FRACTURE BEHAVIOR OF A THERMOPLASTIC MODIFIED EPOXY RESIN

A. MURAKAMI, D. SAUNDERS, K. OOSI, Y. YAMADA, T. YOSHIKI (Himeji Institute of Technology, Japan), M. SAITO, O. WATANABE, and M. TAKEZAWA (Tonen Co., ACM Group, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 13-16. In Japanese.

Carbon fiber reinforced plastics for high elasticity and thermal resistance and low moisture absorption are discussed. The chemical structures of epoxy resins, thermoplastic modifier, and curing agent are described. Effects of resin composition on temperature and Young's modulus are given and test results on interlaminar fracture toughness are listed. Y.P.Q.

A92-41784

THE RELATIONSHIP BETWEEN THE SURFACE ENERGY OF A POLYMER COMPOSITE AND ADHESIVE STRENGTH

H. TATEYAMA, M. TONOGI, K. INOUE, and M. YAMAGATA (Nippon Steel Chemical Co., Ltd., Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 39-42. In Japanese. refs

The Fowkes and Dupre-Young methods are used for computing the surface energy of polymer composites. The measurement of the adhesive strength is described and test results obtained by ESCA are discussed. Y.P.Q.

A92-42559

THERMAL CONDUCTION MECHANISM OF ALUMINIUM NITRIDE CERAMICS

K. WATARI, K. ISHIZAKI (Nagaoka University of Technology, Japan), and T. FUJIKAWA (Kobe Steel Co., Ltd., Isostatic Pressing Centre, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 10, May 15, 1992, p. 2627-2630. refs

Extremely large grain size AlN ceramics were produced by HIP sintering at an ultra-high temperature of 2773 K without reducing the oxygen content, in order to determine experimentally whether the factor controlling thermal conductivity is either grain boundaries or the internal structure of the grains. The room-temperature thermal conductivity of the HIPed AlN with a grain size of about 40 microns was 155 W/m per K, and was almost equal to that of the normally sintered AlN with a grain size of 4 microns. Therefore, thermal conductivity at room temperature is independent of AlN grain size, or the number and amount of grain-boundary phase for reasonably well-sintered AlN ceramics. The calculated phonon mean free path of sintered bodies was 10-30 nm at room temperature, which is too small to compare with the AlN grain size. Consequently, it is shown that the thermal conductivity of sintered AlN is controlled by the internal structure of the grains, such as oxygen solute atoms. Author

A92-42572

PROCESS OF FORMATION OF VAPOUR-GROWN CARBON FIBRES BY GAS-PHASE REACTION USING ULTRAFINE IRON CATALYST PARTICLES

T. KATO, K. KUSAKABE, and S. MOROOKA (Kyushu University, Fukuoka, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, no. 10, May 15, 1992, p. 674-677. refs

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Vapor-grown carbon fibers (VGCF) were prepared through the pyrolysis of benzene and thiophene with floating, ultrafine iron particles in an aerosol reactor. Attention was given to the effects of reaction conditions on fiber properties, and the growth rates of the fibers in both the axial and radial dimensions were measured. The VGCFs were also characterized by TEM and EDAX. O.C.

A92-42811

SYNTHESIS OF DIAMOND USING NON-METALLIC CATALYSTS

MINORU AKAISHI, HISAO KANDA, and SHINOBU YAMAOKA (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 111-116. refs

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Diamond synthesis was confirmed at 7.7 GPa and 2150 C using the powder mixtures of graphite and the catalysts of the carbonates, sulfates, and hydroxides of alkali and alkaline earth metals. When, instead of the powder mixture, a graphite capsule filled with very pure CaCO₃ or Na₂SO₄ powders was treated at the same condition, diamond was also produced in the interface between graphite capsule and the catalyst. Morphology and crystal size of the synthesized diamond were strongly dependent on the sample assembly, the catalyst, and a treating temperature. Diamond crystals obtained from the latter method are about 10 times larger than those of the former one. Diamond crystals with a size of 0.5 mm were synthesized using Na₂SO₄ catalyst. Even at a lower temperature condition of 7.7 GPa, 1750 C, diamond with similar size was reproducibly synthesized. Author

A92-43480

FABRICATION AND FRACTURE BEHAVIOR OF NOVEL SiC CERAMICS HAVING RODLIKE GRAINS

HIRONORI KODAMA and TADAHIKO MIYOSHI (Hitachi, Ltd., Hitachi Research Laboratory, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, no. 6, June 1992, p. 1558-1561. refs

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A new type of silicon carbide having rodlike grains has been fabricated by hot-pressing or hot-pressing followed by hot isostatic pressing using SiC whiskers as the raw powder. Preliminary relationships between sintering conditions and microstructure and fracture toughness of the processed ceramics were established. Ceramics with relative density greater than 98 percent were prepared at temperatures of 2050 C or greater. The fracture toughness of these ceramics was better than that of ordinary SiC, and its maximum value was 7.3 MPa-sq rt m. Grain pullout, grain bridging, and crack deflection were considered to be the main operative mechanisms which led to improved fracture toughness. Author

A92-44659

FRACTURE TOUGHNESS OF SINGLE CRYSTAL SILICON AT HIGH TEMPERATURES

KUNIO HAYASHI (Kyoto Institute of Technology, Japan), SHINJI TSUJIMOTO (Sumitomo Special Metals Co., Ltd., Osaka, Japan), YASUNORI OKAMOTO, and TOMOZO NISHIKAWA (Kyoto Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 463, April 1992, p. 488-494. In Japanese. refs

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The fracture toughness K_{Ic} on the major planes or single-crystal silicon was measured by the controlled surface flaw

(CSF) and indentation fracture (IF) methods at high temperatures. The resulting $K(Ic)$ values from the CSF method for the 100-, 110-, 111-, and 112-plane surface orientation of silicon up to about 500 °C decreased with increasing temperature. In the low-temperature region, the linear decrease of $K(Ic)$ for 110-, 111-, and 112-plane is explained on the basis of an elastic model. The $K(Ic)$ values for 100-, 110-, 111-, and 112-planes of silicon increased rapidly over the temperatures of 500, 600, 700, and 800 °C, respectively. It is found that the rapid $K(Ic)$ increase for those plane at the individual critical temperatures is attributable to extensive plastic yielding in the vicinity of the crack tips relating the Schmid factor and numbers of slip systems for each plane. The $K(Ic)$ values obtained by the IF method for 400-600 °C were larger than those obtained by the CSF method for all planes.

C.D.

A92-44660**CRACK SIZE EFFECT ON CRACK PROPAGATION BEHAVIOR AND EXPERIMENTAL VERIFICATION OF CYCLIC FATIGUE MECHANISM OF SINTERED SILICON NITRIDE**

AKIRA UENO, HIDEHIRO KISHIMOTO (Toyota Technological Institute, Nagoya, Japan), HIROSHI KAWAMOTO (Toyota Motor Corp., Susono, Japan), and YUICHI YAMANAKA (Nippodensho Co., Ltd., Kariya, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 463, April 1992, p. 495-501. In Japanese. refs

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The effect of crack size on the crack propagation behavior of a sintered silicon nitride was investigated by crack propagation tests under cyclic and static loads. Propagation rates of small cracks were slower than that of a long crack in a CT specimen. The crack opening displacement (COD) after cyclic loading was larger than that before cyclic loading. The increase in COD after loading originated from the reduction of bridging force with cyclic fretting at the bridging sites under load. The reduction of bridging force increased $K(I$ tip), which in turn accelerated the crack propagation rate.

C.D.

A92-45345**MECHANICAL PROPERTIES OF SILICON NITRIDE WITH DIFFERENT POWDER PROCESSING ROUTES**

K. NAKAMURA, M. OHASHI, T. NAGAOKA, M. YASUOKA, S. KANZAKI (Government Industrial Research Institute, Nagoya, Japan), and T. SUZUKI (Tonen Corp., Corporate Research and Development Laboratory, Ohi, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, no. 11, June 1, 1992, p. 724-726. refs

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The influence of powder mixture processing routes on the mechanical properties of hot-pressed Si_3N_4 ceramics is studied. The amorphous Si_3N_4 powder used was of high purity. The powder mixture was obtained by two distinct methods. Powder A was prepared by vibratory milling of amorphous Si_3N_4 with various amounts of Y_2O_3 and Al_2O_3 for 6 h in methanol with silicon nitride balls and container, and then calcination at 1400 °C for 1 h under a nitrogen atmosphere of 0.2 MPa. The calcined powders were milled again, dried and sieved through a 150-mesh screen. Powder B was prepared by crystallizing the amorphous Si_3N_4 powder at 1500 °C for 1 h in 0.2 MPa N_2 before mixing with additives. After crystallization the Si_3N_4 powder was mixed with additives, milled and dried under similar conditions to powder A. The representative properties of powders A and B are then compared with regard to bulk density and relationship between bending strength and temperature. It is found that higher-strength silicon nitride ceramics with high Weibull modulus can be obtained from very fine powder which is crystallized from amorphous Si_3N_4 powder with the addition of sintering aids.

S.A.V.

A92-46223**X-RAY PHOTOELECTRON SPECTROSCOPIC STUDIES OF BETA-SIALONS**

T. HAGIO, A. TAKASE, and S. UMEBAYASHI (Government Industrial Research Institute, Tosu, Japan) Journal of Materials

Science Letters (ISSN 0261-8028), vol. 11, no. 12, June 15, 1992, p. 878-880. refs

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XPS spectra are obtained for the core level of constituent atoms of beta-sialons, which could prove useful for the characterization of compositions and chemical states of sialons and related ceramics. The composition of beta-sialons is represented by the formula $Si(6-z)Al(z)O(z)N(8-z)$, where $z = 0$ to 4.2. The Si_3N_4 , AlN , and Al_2O_3 powders presently were mixed to yield sialons of $z = 1, 2, 3$, and 4.

O.C.

A92-47295**THERMAL FATIGUE BEHAVIOR OF ALUMINA CERAMICS BY WATER QUENCHING METHOD**

TADAHIRO NISHIKAWA, TIE GAO (Nagoya Institute of Technology, Japan), MAMORU KOSAKAI (Sumitomo Cement Co., Ltd., Funabashi, Japan), TORU NISHIBE, and MANABU TAKATSU (Nagoya Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 561-566. In Japanese. refs

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Thermal fatigue behavior of four kinds of alumina ceramics with different fracture toughness/bending strength ratios was investigated. For alumina ceramics in which transgranular fracture was observed, the values of the fatigue parameter n hardly differed but log A values decreased with increasing particle size. This indicated that the crack propagation rate became low. For those specimens in which more large particles or pores were observed, the log A values and the crack propagation rate were quite different. The different thermal fatigue behaviors can be explained by different propagation mechanisms at crack tips.

C.D.

A92-47296**X-RAY MEASUREMENT OF TRIAXIAL RESIDUAL PHASE STRESS IN ZIRCONIA-ALUMINA COMPOSITE CERAMICS**

KEISUKE TANAKA (Nagoya University, Japan), MOTOYASU MATSUI (Kyoto University, Japan), RYOICHI SHIKATA (Osaka Cement Co., Ltd., Kaizuka, Japan), and TOMOZO NISHIKAWA (Kyoto Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 593-599. In Japanese. refs

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The X-ray diffraction method was used to measure the residual stress in composite ceramics of zirconia mixed with various volume fractions of alumina. The triaxial state of the residual stress in each phase was determined from the X-ray diffractions of Al_2O_3 (146) by Cu-K alpha radiation and of ZrO_2 (133) by Cr-K alpha radiation. In as-sintered materials, the residual stress in the alumina phase was compressive and decreased linearly with the alumina volume fraction V_f . On the other hand, the tensile residual stress was observed in the zirconia phase, and increased linearly with V_f . Those residual stresses were due to the mismatch of the coefficient of thermal expansion. The theoretical prediction based on Eshelby's inclusion mechanics agreed well with the experimental results.

Author

A92-47297**EFFECT OF ALUMINA ADDITION ON BENDING FRACTURE BEHAVIOR IN Y-PSZ**

HARUSHIGE TSUBAKINO, MITSU HARU HAMAMOTO, KAZUNORI SONODA, and RYOICHI NOZATO (Himeji Institute of Technology, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 631-636. In Japanese. refs

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The bending fracture behavior of ZrO_2 -3 mol pct Y_2O_3 (PSZ) containing 0 to 12 wt pct Al_2O_3 was studied with reference to the tetragonal-to-monoclinic phase transformation by three-point bending test, XRD, SEM-EDS, and dilatometry. PSZ fractured at the stress just over the elastic limit. In PSZ containing Al_2O_3 , on the other hand, the plastic elongation and serration phenomena were clearly observed. The resulting fracture stress increased with the addition of Al_2O_3 . The grain size and density were almost

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independent of the addition of Al_2O_3 . The segregation of both Y_2O_3 and Al_2O_3 at grain boundaries was observed in PSZ containing Al_2O_3 . The different fracture modes in PSZ containing Al_2O_3 could be attributed to this grain-boundary segregation phenomena. Author

A92-47323

PULSE RADIOLYSIS STUDIES OF POLYMERS

SEIICHI TAGAWA (Tokyo, University, Tokai, Japan) IN: Radiation effects on polymers. Washington, DC, American Chemical Society, 1991, p. 2-30. refs

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Recent picosecond and nanosecond electron-beam, ion-beam, and synchrotron radiation pulse radiolysis studies of polymers are reviewed. Transient absorption and emission spectra of short-lived reactive intermediates such as electrons, radical anions and cations, excited states, and neutral radicals have been observed in various irradiated solid polymers and polymer solutions. L.M.

A92-48156

TRIBOLOGICAL CHARACTERISTICS OF POLYCRYSTALLINE DIAMOND FILMS PRODUCED BY CHEMICAL VAPOR DEPOSITION

M. KOHZAKI, K. HIGUCHI, S. NODA, and K. UCHIDA (Toyota Central Research and Development Laboratories, Inc., Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, no. 7, July 1992, p. 1769-1777. refs

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The present investigation of polycrystalline diamond films' surface roughness and crystallinity on tribological characteristics gives attention to ball-on-disk test environment-related effects. While diamond films of high quality were more resistant to wear than low quality ones, friction coefficients were not affected by the crystallinity of the diamond films tested. The diamond films' tribological characteristics deteriorated with increasing sliding speed and ambient temperature; at 600 C in dry N_2 , the friction coefficient of diamond film against an SiC ball was about 0.8, or an order of magnitude greater than in air at ambient temperature. O.C.

A92-49698

ELECTRONIC STRUCTURE BEHIND THE MECHANICAL PROPERTIES OF BETA-SIALONS

I. TANAKA (Osaka University, Ibaraki, Japan), S. NASU (Osaka University, Toyonaka, Japan), H. ADACHI (Hyogo University of Teacher Education, Yashiro, Japan), Y. MIYAMOTO, and K. NIHARA (Osaka University, Ibaraki, Japan) Acta Metallurgica et Materialia (ISSN 0956-7151), vol. 40, no. 8, Aug. 1992, p. 1995-2001. refs

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High-purity beta-sialons, $\text{Si}(6-z)\text{Al}(z)\text{O}(z)\text{N}(8-z)$ have been fabricated by hot isostatic pressing, and their mechanical properties were examined. Young modulus and Vickers hardness decreased almost linearly with the increase of z-value. The decrease was ascribed to the lattice softening, which as confirmed by Raman spectroscopy. At high temperatures, creep rate of sintered materials and also sintering rate of powders were significantly enhanced with the increase of z-values. Molecular orbital calculations for model clusters were performed by means of discrete-variational (VD) X-alpha method. The electronic structures were quantitatively evaluated by Mulliken population analysis. Strength of covalent bonding expressed as overlap population was found considerably decreased at around the solute atoms, especially at Al atoms, which has been proposed as the electronic mechanism behind the above properties of beta-sialons. Author

A92-49912

POSSIBLE STRUCTURAL MODELS OF N-DIAMOND - A MODIFIED FORM OF DIAMOND

HISAKO HIRAI, KEN-ICHI KONDO (Tokyo Institute of Technology, Yokohama, Japan), and HIROSHI SUGIURA (Yokohama City University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 4, July 27, 1992, p. 414-416. refs

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A few possible structural models of n-diamond, which is a modified form of diamond quenched from shock-compressed graphite, are proposed on the basis of observed electron-diffraction patterns. From the structural relationship and transition mechanism, the most favored structure is composed of hexagonal-ring-planes moderately puckered with opposite direction to that of cubic ($\text{Fd}3\text{m}$) diamond, having a peculiar bonding state different from exact sp^2 and sp^3 . Author

A92-50125

INVESTIGATION OF INSTRUMENTED IMPACT TEST AND LOADING RATE DEPENDENCY OF FRACTURE TOUGHNESS IN BRITTLE POLYMERS

ISAMU YAMAMOTO (Toyohashi University of Technology, Japan), HIROSHI MIYATA (Nissan Motor Co., Ltd., Zama, Japan), and TOSHIRO KOBAYASHI (Toyohashi University of Technology, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, no. 3, July 1992, p. 361-366. refs

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A test method for dynamic fracture toughness of brittle polymers has been studied. Differences in the impact response curves obtained by the instrumented Charpy test and the one-point bend test are compared. It is concluded that a vibrational wave can be prevented using a small specimen that shortens its period. A shock-absorbing material is used to lower the load value. Differences in the impact response curves and fracture times obtained from the instrumented Charpy impact test and the one-point bend test are rather large at the lower impact velocity of 3.10 m/s. O.G.

A92-50198

LONG-TERM TENSILE CREEP TESTING FOR ADVANCED CERAMICS

TATSUKI OHJI and YUKIHIKO YAMAUCHI (Government Industrial Research Institute, Nagoya, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, no. 8, Aug. 1992, p. 2304-2307. Research supported by Ministry of International Trade and Industry. refs

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A tensile creep test technique for long-term (10,000 h or more) measurement is described. A specimen is gripped by ceramic grips with a simple design in the hot zone of a furnace. By optimizing the grip geometry, the ratio of the parasitic bending strain to the average tensile strain can be suppressed to less than 1 percent. The careful hand polishing to remove machining flaws has been found essential for reliable creep tests. The long-term test is demonstrated for silicon carbide at 1400 C under a stress of 200 MPa, by routinely replacing the heat elements, thermocouples, etc., during the test. The stability of the creep curve, which has been obtained by an optical extensometry system, is normally within ± 2 microns. Author

A92-51387

DEVELOPMENT AND APPLICATION OF POLYCARBODIIMIDE COMPOSITE MATERIALS

KIYOTAKE MORIMOTO and YASUO IMASHIRO (Nisshinbo Industries, Inc., Tokyo, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 798-803. In Japanese. refs

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A novel method for synthesizing high-molecular-weight polycarbodiimides having linear structure is described. The resulting polycarbodiimides can be easily processed as a matrix resin for various composites. For instance, polymers with high temperature stability can be fabricated by the reaction between a linear polycarbodiimide and a triazine-type crosslinking agent at an elevated temperature. Self-crosslinking can occur at the same time to produce dimer and trimer carbodiimide linkages. Two kinds of stampable sheets were developed by applying the resin to their matrix. Both sheets showed superior temperature resistance and thermal insulation properties. I.S.

A92-51388

COMPARISON OF FATIGUE BEHAVIOR OF POLYAMIDES WITH DIFFERENT MOLECULAR STRUCTURES

AKIHIKO MORIKAWA, TAKATOSHI ISHIGAKI, SHUJI TSUCHIKAWA, and SHINICHI KIMURA (Japan Synthetic Rubber Co., Ltd., Development Center, Yokkaichi) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 804-807. In Japanese. refs

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The effect of molecular structure on the fatigue behavior of polyamides was investigated using results from stress-controlled fatigue tests on polyamide 66, polyamide 46, and polyamide 6, performed using a tension-tension-type fatigue tester. At stress amplitudes tested, polyamides 46 and 66 showed a thermal (ductile) failure behavior in the large stress amplitude region and a brittle failure at smaller stress amplitudes, whereas polyamide 6 showed only the thermal failure behavior. The transition stress level from thermal to brittle failure was higher for polyamide 46 than for polyamide 66. I.S.

A92-51389

INFLUENCE OF GELLING CONDITION ON MECHANICAL PROPERTIES OF SIMULTANEOUS INTERPENETRATING POLYMER NETWORKS FROM EPOXY RESIN/POLYBISMALEIMIDE SYSTEMS

KATSUYOSHI IISAKA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Amagasaki, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 821-826. In Japanese. refs

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A92-51392

FRACTURE TOUGHNESS AND TRANSITION OF FRACTURE BEHAVIOR OF SILICON NITRIDE AT ELEVATED TEMPERATURES

NOBUYUKI MIYAHARA, YOSHIHARU MUTOH (Nagaoka University of Technology, Japan), KOHEI YAMAISHI (Isuzu Ceramics Research Institute Co., Ltd., Fujisawa, Japan), and TSUNEO OIKAWA (NKK Corp., Kawasaki, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 892-898. In Japanese. refs

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Fracture behavior in HIP-sintered silicon nitride at elevated temperatures was investigated using results of fracture toughness tests. It was found that the fracture toughness gradually decreased with increasing temperature up to 1200 C. Then, in the temperature range 1200-1275 C, a steellike brittle-to-ductile transition of fracture toughness was observed, where the fracture toughness rapidly increased from 4 MPa sq rt m to 8 MPa sq rt m. I.S.

A92-51416

LARGE-SCALE SYNTHESIS OF CARBON NANOTUBES

T. W. EBBESEN and P. M. AJAYAN (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan) Nature (ISSN 0028-0836), vol. 358, no. 6383, July 16, 1992, p. 220-222. refs

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The synthesis of graphitic nanotubes in gram quantities using a variant of the standard arc-discharge technique for fullerene synthesis under a helium atmosphere is reported. Under certain conditions a carbonaceous deposit forms on one of the graphite rods, consisting of a macroscopic cylinder in which the core comprises pure nanotubes and nanoscale particles in high yield. The purity and yield depend sensitively on the gas pressure in the reaction vessel. Preliminary measurements of the conductivity of the bulk nanotube material indicate a conductivity of about 100 S/cm. C.D.

A92-51842

APPLICATION OF A HALL ACCELERATOR TO DIAMONDLIKE CARBON FILM COATINGS

MORIHIRO OKADA (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan), HISAYUKI TOKU, YASUSHI YAMAMOTO, and KIYOSHI YOSHIKAWA (Kyoto

University, Uji, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1845-1854. refs

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A Hall accelerator-type ion source for low-voltage continuous operation (hereafter called HALOC) without any exhaustible filaments, designed for film coating purposes, has successfully produced a large-area low-energy continuous beam of methane or oxygen. The thin film of carbon uniformly coated on a steel plate by the HALOC has been found to be a typical amorphous hard carbon film with high Vickers hardness, strong adhesion, and strong anticorrosion properties. The causes of strong adhesion of the film have been studied. Author

A92-52528

STATIC AND DYNAMIC FINITE ELEMENT ANALYSIS OF TRANSFORMATION TOUGHENING IN CERAMIC MATERIALS

YUTAKA TOI and DAIGORO ISOBE (Tokyo, University, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 42, no. 6, Aug. 1992, p. 911-924. refs

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Computational studies have been conducted for the phenomenon of 'transformation toughening' which is observed in zirconia-containing ceramics such as PSZ. The new constitutive modeling for transformation plasticity in which a stress history-dependent internal state variable is employed has been applied to the finite element analysis of stationary and growing macrocracks under static and dynamic loading. The transformation toughening effect is discussed, along with the influence on it of the size of the transformed damage zone and the various parameters in the equations to be solved, through the observation of the behavior of the general crack tip energy release parameter. Author

A92-52695

SOLUTION EFFECT ON THE SLOW CRACK GROWTH RESISTANCE OF DILUTE SIALONS AT HIGH TEMPERATURES

I. TANAKA, G. PEZZOTTI, T. OKAMOTO, and K. NIHARA (Osaka University, Ibaraki, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 15, Aug. 1, 1992, p. 4089-4096. refs

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High purity Si₃N₄ powder was sintered with only 0.5-1.0 wt pct AlN by HIP and its delayed failure behavior at around 1400 C has been studied with interest to determine the role of Al atoms. Al atoms are found completely dissolved in the Si₃N₄ matrix as dilute sialon solid solutions by detailed analyses of phase composition. Flaw sensitivity increased considerably with the AlN addition, which was ascribed to the decrease in slow crack growth (SCG) resistance. Static-load lifetime under the same stress was remarkably decreased by the addition, which showed good agreement with that predicted from the experimentally obtained SCG resistance. Internal friction behavior as well as microstructural investigation found no intergranular mechanisms for the SCG enhancement. Solution effect of Al and O atoms in the beta-Si₃N₄ matrix, and the resulting virtual defect of covalent bonding, was proposed to be their origin. Author

A92-53512

IRRADIATION EFFECTS OF LOW ENERGY IONS ON POLYMER FILMS FOR SPACECRAFTS

MASAHIRO OTA (Tokyo Metropolitan University, Japan), TOSHIKI YOKOTA (Ehime University, Matsuyama, Japan), HIROSHI YOSHIDA, TETSUYA YONEDA (Tokyo Metropolitan University, Japan), SUSUMU SASAKI, AKIRA YAMORI, and NOBUKI KAWASHIMA (Institute of Space and Astronautical Science, Sagami, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 455-460. refs

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Irradiation effects of oxygen ions on the molecular motion of polymers (BPDA type 3, 4, 3', 4'-biphenyltetracarboxylic dianhydride) have been examined. The collision influences of the

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positive oxygen ions extend only to the extreme surface of the polyimide films. The transmittance of the visible light at the wave length of 5330 Å, decreases by 5 percent after 60 minutes irradiation of the oxygen ions. The irradiated sample shows high intensity of the absorption band at 1700/cm. The absorption band is assigned to the stretching vibration of a carbonyl group in an aromatic ring. The dynamic storage moduli of the irradiated samples are larger than that of the original sample in all temperature ranges. The irradiation effects by positive oxygen ions on advanced prepreps are not clearly observed. Author

A92-53987 GROWTH OF FACE-CENTERED-CUBIC SINGLE CRYSTALS OF C60 FROM BOILING BENZENE

YOSITAKA YOSIDA (Iwaki Meisei University, Japan), TAKESHI ARAI, and HIROYOSHI SUEMATSU (Tokyo, University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 9, Aug. 31, 1992, p. 1043, 1044. refs
Copyright

A synthesis technique is reported for face-centered-cubic single crystals of C60 with a macroscopic dimension of 0.3 x 0.3 x 0.5 cu mm. The crystals are grown from benzene heated above 80 C. The mosaic spread of the crystal is about 0.5 degrees. Author

A92-54508 SINTERING AND MICROSTRUCTURE OF SILICON NITRIDE PREPARED BY PLASMA CVD

Y. MORIYOSHI, M. FUTAKI (National Institute for Research in Inorganic Materials, Tsukuba, Japan), N. EKINAGA, and T. NAKATA (Tokai Carbon Co., Ltd., Fuji Laboratory, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 16, Aug. 15, 1992, p. 4477-4482. refs
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A92-54704 COMPOSITION CHANGE OF SiC(X) (X=1-2) FILMS DUE TO VARIATION OF FILM PRECURSORS IN THE Si2H6/C2H2 CHEMICAL VAPOR DEPOSITION REACTION SYSTEM

LU-SHENG HONG, YUKIHIRO SHIMOGAKI, YASUYUKI EGASHIRA, and HIROSHI KOMIYAMA (Tokyo, University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 8, Aug. 24, 1992, p. 910-912. refs
Copyright

A92-55096 PHASE DIAGRAM OF Al2O3-Y2O3-SiO2 OXIDES SYSTEM AND ITS APPLICATION TO CERAMICS

YUICHIRO MURAKAMI and HIROKAZU YAMAMOTO (Mitsubishi Heavy Industries, Ltd., Advanced Technology Research Center, Yokohama, Japan) Mitsubishi Heavy Industries Technical Review (ISSN 0026-6817), vol. 29, no. 2, June 1992, p. 85-90. refs
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A92-55407 STRUCTURE AND PROPERTIES OF PLASMA-SPRAYED SIALON COATINGS

S. SODEOKA, K. UENO (Government Industrial Research Institute, Osaka, Japan), Y. HAGIWARA (Osaka Electronics and Communications University, Japan), and S. KOSE (Government Industrial Research Institute, Osaka, Japan) Journal of Thermal Spray Technology (ISSN 1059-9630), vol. 1, no. 2, June 1992, p. 153-159. refs
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$\text{Si}(6-z)\text{Al}(z)\text{O}(z)\text{N}(8-z)$ where $z = 1, 2, 3$, or 4 was plasma sprayed in air, and the structure and properties of the coating were evaluated. Coatings of the Sialon could be produced when $z = 3$ or 4 , whereas coatings were hardly formed for Sialon with $z = 1$ and 2 . The relative density and the Vickers hardness of the Sialon coatings ($z = 3$ and 4) increased with an increase in plasma power. Elemental analysis and X-ray diffractometry revealed that Sialon partially decomposed during thermal spraying. Nitrogen

gas addition to the secondary plasma gas was effective in suppressing this decomposition. Author

A92-55415 JOINING SIALON CERAMICS USING COMPOSITE BETA-SIALON-GLASS ADHESIVES

PHILIP A. WALLS and MASANORI UEKI (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, no. 9, Sept. 1992, p. 2491-2497. refs
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Commercial beta-Sialon ceramics were joined using mixed Si_3N_4 , Y_2O_3 , Al_2O_3 , and SiO_2 powders. At a joining temperature of 1600 C and a hold time in excess of 10 min, the adhesive was converted to an approximate 60:40 vol pct composite of beta-Sialon-glass-ceramic. The grain size of the acicular beta-Sialon grains precipitated in the joint (submicrometer diameter, average aspect ratio of 10) was significantly smaller than those in the adherend ceramic (1-5 micron diam). Intergrowth of beta-Sialon grains at the joint interface resulted in high bond strengths. The chemistry and microstructure of the ceramic adhesives used are described. Author

A92-55887 FRACTURE BEHAVIOR AND FRACTURE TOUGHNESS OF CeO2-STABILIZED ZrO2 UNDER MIXED MODE LOADINGS

YASUO KOGO (Mitsubishi Electric Co., Sagamihara, Japan), YUTAKA KAGAWA (Tokyo, University, Japan), and HIROSHI HATTA (Institute of Space and Astronautical Science, Sagamihara, Japan) Japan Institute of Metals, Journal (ISSN 0021-4876), vol. 56, no. 7, July 1992, p. 770-778. In Japanese. refs
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Fracture toughness tests were conducted on specimens of CeO2-stabilized ZrO2 under mode I, mode II, and mixed-mode loading. It is found that the maximum principal stress criterion and the noncoplanar strain energy release rate criterion are applicable to the KI-KII fracture curve. Under mode II loading, the KIIc/KIc value is found to equal 0.6, which is lower than the value typically observed for nontransforming brittle materials. The observed low KIIc/KIc value is attributed to the shielding effect of the transformation which affects the mode I stress intensity only. V.L.

A92-56196 PREFERRED ORIENTATION OF HIGH PERFORMANCE CARBON FIBERS

T. HAMADA, M. FURUYAMA, T. TOMIOKA (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan), and M. ENDO (Shinshu University, Nagano, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, no. 9, Sept. 1992, p. 2612-2620. refs
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The X-ray diffraction technique is used to study the preferred orientation of PAN-based carbon fibers, mesophase pitch-derived carbon fibers, and pitch precursor fibers. The half width at half maximum intensity of the phi scan X-ray diffraction profiles of these fibers was a minimum at around $2\theta = 26$ deg. It is inferred that a crystallite with a larger coherence length of crystallite size $L_c(002)$ is better aligned along the fiber axis than that with a smaller $L_c(002)$ in these fibers. Also, theta-2theta scan profiles depending on phi showed that a better aligned crystallite possesses a larger $L_c(002)$ than a misaligned one. The pitch precursor fiber exhibited a clear peak at about $2\theta = 7$ deg in the theta-2theta profile and unusual phi scan profiles for 2θ around 7 deg. The periodic column stacking structure observed in the pitch precursor fiber was also detected in the pitch-based carbon fibers heat-treated at lower temperatures. P.D.

N92-16125# Japan Atomic Energy Research Inst., Tokyo. RADIATION RESISTANCE OF ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE AND POLYETHERETHERKETONE AS MATERIALS FOR GASKET AND SEALING

TADAO SEGUCHI, NAOTAKA NAKAGIRI, and MICHIIRO KOIKE Nov. 1990 35 p In JAPANESE; ENGLISH summary (DE91-780207; JAERI-M-90-204) Avail: CASI HC A03/MF A01

Radiation resistance of ultra high molecular weight polyethylene (NL-W) and polyetheretherketone (PEEK-450G) was tested to select the gasket and sealing materials used in the piping and valve for high level radioactive liquid in reprocessing of nuclear fuel. The tensile, bending, hardness, and seal tests were carried out after Co-60 gamma ray irradiation in air, in oxygen under pressure, and in nitric acid of 3N and 10N at room temperature. For NL-W, the degradation was small until 3.2 MGy by the irradiation in air and in nitric acid, then the sealing was maintained. However, the degradation was observed by the irradiation in oxygen under pressure, then, the physical properties and sealing would be gradually lost with dose in air at very low dose rate irradiation. For PEEK-450G, the radiation degradation was very small in the these irradiation conditions, but it was observed to degrade at a high temperature in a high concentration of nitric acid. DOE

N92-16133# Japan Atomic Energy Research Inst., Tokyo.

CONSTRUCTION OF APPARATUS FOR CURING BY ELECTRON IRRADIATION AND ITS CHARACTERISTICS

NOBORU KASAI (Japan Atomic Energy Research Inst., Tokyo.), MASANOBU NISHII (Japan Atomic Energy Research Inst., Tokyo.), and TADAO SEGUCHI (Japan Atomic Energy Research Inst., Takasaki.) Apr. 1991 41 p In JAPANESE; ENGLISH summary (DE91-522099; JAERI-M-91-064) Avail: CASI HC A03/MF A01

An apparatus was designed and constructed for electron irradiation curing treatments of organic silicone fibers as the precursor of silicon carbide (SiC) fibers. Using the apparatus, the organic silicone fibers were cured by electron beam crosslinking, and the active species formed were quenched by heating up to 1173 K in an oxygen free atmosphere. This apparatus is composed of two sample trays, irradiation chamber, middle container, heating container, electric furnace, and vacuum pump. The sample tray is moved from irradiation chamber to heating container through the middle container. Irradiation chamber, middle container, and heating container are separated by airtight shutters. It was observed that the air leak is negligible, and the oxidation was well prevented during the radiation curing. The absorbed dose was 14.4 kGy per double pass by using an electron beam of 2MeV and 1mA with 100 cm/min of sample tray moving speed. The temperature rise of the sample by electron irradiation was depressed by helium gas flow and with the supply of liquid nitrogen to the radiator inside of the irradiation container. The temperature in the heating container showed rather large distribution at the higher temperature. DOE

N92-17193# Pennsylvania State Univ., University Park.
THE 5TH ANNUAL US-JAPAN SEMINAR ON DIELECTRIC AND PIEZOELECTRIC CERAMICS Final Report, 1 Jun. 1990 - 21 Oct. 1991

JOSEPH P. DOUGHERTY Oct. 1991 36 p Seminar held in Kyoto, Japan, 11-14 Dec. 1990 (Contract N00014-90-J-1928) (AD-A243465) Avail: CASI HC A03/MF A01

The Fifth United States/Japan Workshop on Dielectric and Piezoelectric Materials was held in Kyoto, Japan on December 11-14, 1990. The technical topics most discussed were: (1) thin film ferroelectrics and dielectrics, (2) relaxor ferroelectrics, and (3) piezoelectric materials and processing. Barium titanate materials for multilayer capacitors received little attention. There were no USA papers on microwave dielectrics and no Japanese papers on single crystals. There were no USA papers on piezoelectric devices, while many Japanese papers were device related. Dielectric materials for electronic packaging were few from both sides. GRA

N92-23134# Japan Atomic Energy Research Inst., Tokyo.

RADIATION EFFECTS ON POLYETHYLENE FOAM

BEILIN TANG, KANAKO KAJI, MOTOYOSHI HATADA, IWAOKA

YOSHIZAWA, and CHOJI KOHARA Sep. 1991 53 p In JAPANESE; ENGLISH summary (DE92-751046; JAERI-M-91-134) Avail: CASI HC A04/MF A01

Studies have been carried out on radiation effects on open cell type polyethylene foam. The foam was irradiated with electron beam either in nitrogen atmosphere or in air and changes of strength, elongation, and gel fraction were measured. The gel-percent of the original foam (50 percent) increased by 30 percent after irradiation in nitrogen, while strength measured at room temperature, 70 C, and 100 C did not change by their radiation. However, elongation measured at 70 C and 100 C decreased considerably and dimensional stability above 70 C was also improved. DOE

N92-29195# Sandia National Labs., Albuquerque, NM.

ION CONDUCTIVE POLYMER SOLID ELECTROLYTES

HIDEKAZU IZUCHI and TOMOHIKO NODA 26 Feb. 1992 9 p Transl. into ENGLISH of Japanese Patent Application No. HE13-59058 (14 Mar. 1991) (Contract DE-AC04-76DP-00789)

(DE92-010518; ALS/TR-92-009) Avail: CASI HC A02/MF A01

The high polymer solid electrolyte is an immobile solvent formed of a lattice of mutually soluble polyvinylidene fluoride, solvent A, and ion-dissociable salt. The electrolyte is manufactured by dissolving in solution stoichiometric amounts of polyvinylidene fluoride, solvent A (mutually soluble with, and a swelling agent for polyvinylidene fluoride), solvent B, and an ion-dissociable salt. Solvent B is extracted in a subsequent step. An alternate manufacturing procedure by which to produce a high polymer solid electrolyte is to dissolve an ion-dissociable salt in solvent B. The high polymer solid electrolyte lattice consists of polyvinylidene fluoride solvated by roughly stoichiometrical amounts of solvent A and ion-dissociable salt. A novel feature of the electrolyte is that it is essentially solid, and yet ions released by dissociation of the salt when solvated by solvent A migrate mainly through solvent A, resulting in high ionic conductivity. DOE

N92-30502# National Inst. for Fusion Science, Nagoya (Japan).

REVIEW OF HIGH Z MATERIALS FOR PSI APPLICATIONS

TETSUO TANABE (Osaka Univ., Japan), NOBUAKI NODA, and HIROO NAKAMURA (Japan Atomic Energy Research Inst., Naka.) Jun. 1992 49 p Presented at the 10th International Conference on Plasma Surface Interactions in Controlled Fusion Devices, Monterey, CA, 30 Mar. - 3 Apr. 1992 Submitted for publication (ISSN 0915-633X)

(NIFS-152; AD-B166256) Avail: CASI HC A03/MF A01

Application of carbon based low Z materials of plasma facing materials (PFM) has significantly improved plasma parameters in large tokamaks. There are, however, serious concerns of erosion, neutron damage, etc. for application of low Z materials in future D-T burning machine. To apply high Z metals to PFM, there are several issues to be solved; high Z impurity production by sputtering, their accumulation in plasma center, and high radiation loss. Because of these concerns high Z metals are not widely employed nor planned to be used in the present large tokamaks. Since our efforts were concentrated to optimize the low Z materials, few systematic investigations for high Z materials in a tokamak were done; thus, the data base lacks information concerning impacts on the plasma core. In order to employ high Z material as PFM in the near future, material properties related to impurity production and hydrogen recycling are reviewed and discussed. Author

N92-31146# EG and G Rocky Flats, Inc., Golden, CO.

A METHOD FOR REGENERATING ION EXCHANGE RESIN

MASAHIRO OGIHARA, KENICHI ICHIKAWA, and TAKESHI IDEMIZU Dec. 1991 9 p Transl. into ENGLISH of Japanese Patent No. HE1-3-154642 (2 Jul. 1991) (Contract DE-AC34-90DP-62349)

(DE92-015312; RFP-TRANS-525) Avail: CASI HC A02/MF A01

This invention is comprised of a method for regenerating ion exchange resin consisting of a mixed resin. The mixed resin contains a granular cation exchange resin and anion exchange

28 PROPELLANTS AND FUELS

resin contaminated during condensation treatment in steam power generating plants. The mixed resin is separated into cation exchange resin and anion exchange resin, and the separated cation exchange resin is regenerated by immersion in aqueous acidic solution for more than 5 hours. It also consists of a method for regenerating ion exchange resin according to claim 1. The aqueous acidic solution is sulfuric acid, hydrochloric acid, or nitric acid solution. DOE

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PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

A92-11741

IGNITION OF AP-BASED COMPOSITE SOLID PROPELLANTS CONTAINING NITRAMINES EXPOSED TO CO₂ LASER RADIATION AT SUBATMOSPHERIC PRESSURES

TAKEO SAITO, MASATAKA SHIMODA, TOSHIO YAMAYA, and AKIRA IWAMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) *Combustion and Flame* (ISSN 0010-2180), vol. 85, May 1991, p. 68-76. Research supported by Foundation for the Promotion of the Industrial Explosives Technology of Japan. refs
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Ignition characteristics of AP-based composite solid propellants that contained either RDX or HMX, are investigated utilizing a CO₂ laser at relatively low heat flux and subatmospheric pressures to simulate space environments and also to simplify understanding of the nature of ignition phenomena. Results are presented graphically as a function of ambient pressure and surface heat flux. The ignition process is found to be roughly divided into two regions of self-sustaining ignition and non-self-sustaining ignition, depending on whether the ignition reaction is self-sustained or extinguished when the external radiation is interrupted after ignition. R.E.P.

A92-16591

BURNING RATE CATALYSIS OF AZIDE/NITRAMINE PROPELLANTS

N. KUBOTA and T. SONOBE (Japan Defense Agency, Technical Research and Development Institute, Tachikawa) IN: Symposium (International) on Combustion, 23rd, Orleans, France, July 22-27, 1990, *Proceedings*. Pittsburgh, PA, Combustion Institute, 1991, p. 1331-1337. refs
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In order to improve the burning rate characteristics of azide/nitramine propellants composed of energetic azide polymer and energetic crystalline nitramine particles, the effect of the addition of catalysts on the combustion wave structure was studied. Glycidyl azide polymer (GAP) was used as an energetic azide polymer, and cyclotetramethylene tetranitramine (HMX) was used as an energetic nitramine particles. The burning rate of GAP/HMX propellant was increased significantly by the addition of 2.0 percent lead citrate and 0.6 percent carbon. The measurements of the flame structure and the temperature distribution in the gas phase were conducted with microphotographs and microthermocouples. The results indicate that the luminous flame was produced some distance above the burning surface and the flame standoff distance was increased when the catalyst was added. However, the reaction rate to produce the luminous flame was not affected by the catalyst. Both the heat flux transferred back from the first-stage gas phase zone just above the burning surface and the heat released at the burning surface were determined to be increased by the addition of the catalyst. Author

A92-21720

A MODEL OF TRANSIENT COMBUSTION OF SOLID PROPELLANTS

TAKESHI TACHIBANA (Kyushu Institute of Technology, Kitakyushu, Japan) and HIROHISA KURIBAYASHI (Asahi Chemical Industry Co., Ltd., Oita, Japan) *Japan Society for Aeronautical and Space Sciences, Transactions* (ISSN 0549-3811), vol. 34, Nov. 1991, p. 131-138. refs

A model is developed that is useful for the estimation of the transient combustion behavior of a newly designed rocket motor and which can demonstrate how much each parameter related to the motor configuration or propellant properties affects the transient combustion. A sample computation simulates the case of dynamic extinction, but could also be applied to the case of the transient phenomena of thrust magnitude control by nozzle area variation. The results of theoretical calculations of the effect of motor configuration and propellant properties, particularly the pressure exponent, the vent opening ratio and time, and erosive and unsteady effects are presented. R.E.P.

A92-24472

ENERGETIC SOLID FUELS FOR DUCTED ROCKETS. II

N. KUBOTA, Y. YANO, K. MIYATA (Japan Defense Agency, Technical Research and Development Institute, Tokyo), T. KUWAHARA, M. MITSUNO, and I. NAKAGAWA (Nissan Motor Co., Ltd., Aeronautical and Space Div., Tokyo, Japan) *Propellants, Explosives, Pyrotechnics* (ISSN 0721-3115), vol. 16, Dec. 1991, p. 287-292. refs
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The combustion characteristics of variable-flow ducted rockets were evaluated in order to obtain optimum design parameters of the gas generators. The energetic solid fuels used for the gas generators were glycidyl azide polymer (GAP) with burning rate catalysts. The burning rate of GAP based energetic fuels was much higher than that of composite and double-base based fuel-rich propellants. The pressure exponent of the burning rate was high enough to obtain a wide range of variable-flow rate. Two types of combustion test were conducted: a semi-free jet and a direct connect flow. The pressure-time response in the primary combustor obtained by the use of a throttleable nozzle was evaluated. Author

A92-32921

ENERGETICS OF BAMO

TOSHIO MIYAZAKI (Daicel Chemical Industries, Ltd., Hyogo, Japan) and NAMINOSUKE KUBOTA (Japan Defense Agency, Technical Research and Development Institute, Tachikawa) *Propellants, Explosives, Pyrotechnics* (ISSN 0721-3115), vol. 17, Feb. 1992, p. 5-9. refs
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3,3-Bis(azidomethyl)oxetane (BAMO) is a typical energetic azide polymer containing two N₃ bonds in the molecular structure. Since BAMO is a solidified polymer at room temperature, a liquid BAMO copolymer with tetrahydrofuran (THF) was synthesized in order to gain energetic binders for solid propellants. Various types of experiments were carried out to elucidate the decomposition and combustion processes of BAMO polymer, BAMO/THF copolymer, and crosslinked BAMO/THF copolymer. The heat produced by the decomposition is caused by the bond breakage of -N₃ to produce N₂ gas. The burning rate characteristics of crosslinked BAMO/THF copolymer depend largely on the mole fraction ratio of BAMO and THF. Author

A92-43455

TEMPERATURE SENSITIVITY OF SOLID PROPELLANTS AND AFFECTING FACTORS - EXPERIMENTAL RESULTS

N. KUBOTA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) IN: *Nonsteady burning and combustion stability of solid propellants*. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1992, p. 111-143. refs
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A simplified analysis is presented of the temperature-sensitivity

mechanism based on the heat-feedback process in the combustion wave. Combustion-wave structures are analyzed in terms of physical and chemical parameters which are described as a function of temperature. Separate treatment is given to different classes of propellants including ammonium perchlorate composite, double-base, composite modified double-base, nitramine composite, and azide polymer propellants. The temperature-sensitivity analyses are described for each propellant type and for the addition of catalysts or with high concentrations of certain elements or compounds. Extensive graphic information is given regarding the adiabatic flame temperatures and burning-rate characteristics of propellant mixtures such as noncatalyzed GAP/HMX. The review is of use in the design and selection of propellants with different temperature sensitivities and combustion structures. C.C.S.

A92-43458

FLAME STRUCTURE OF MODERN SOLID PROPELLANTS

N. KUBOTA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) IN: Nonsteady burning and combustion stability of solid propellants. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1992, p. 233-259. refs

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The flame structures of high-energy propellant ingredients and solid propellants are reviewed to study the heat-transfer process in the combustion wave and burning-rate characteristics. Thermochemical analysis and temperature-distribution measurements of the combustion wave are used to determine heat-feedback parameters and reaction rates in the gas phase in propellants with and without catalysts. Flame structure is shown to be primarily dependent on various physicochemical properties such as mixture ratios, and the heat flux transferred from the luminous flame to the burning surface has a negligible effect on the burning rate. C.C.S.

A92-49105#

COMBUSTION OF SOLID FUELED RAMJET. I

I. NAKAGAWA and T. KUWAHARA (Nissan Motor Co., Ltd., Tokyo, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 8 p. refs (AIAA PAPER 92-3727) Copyright

A ducted solid-fueled ramjet is proposed consisting of a primary combustor to produce reactive gases and a secondary combustor to produce final combustion gases. The solid fuels for this ramjet consist of AP as an oxidizer, and carboxyl-terminated polybutadiene mixed with boron particles as a fuel. The combustion characteristics of this fuel were evaluated for various air-flow conditions, using a specially designed direct connect flow facility. I.S.

A92-49106#

COMBUSTION OF SOLID FUELED RAMJET. II

A. IIDA (Asahi Chemical Industry Co., Ltd., Ohita, Japan) and I. KOMAI (Nippon Oil and Fats Co., Ltd., Aichi, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 7 p. refs (AIAA PAPER 92-3728) Copyright

In order to improve the combustion performance of solid fueled ramjets, a solid fueled ramjet (DSFR) is introduced in this study. DSFR consists of a primary combustor and a secondary combustor. However, no choked flow exists between both combustors. The gas generator in the primary combustor burns at the stagnation pressure of the secondary combustor which is generated by the induced air from the atmosphere. The results of the flight-performance analysis conducted in this study indicate that the flight distance extends drastically with increasing the flight altitude even though the net impulse is independent of the altitude. In order to operate DSFR effectively, the pressure exponent of burning rate of the fuel-rich propellants is required to be 1.

Author

A92-53475

COMBUSTION CHARACTERISTICS OF METALLIZED HYDROCARBON FUELS

N. YATSUYANAGI, H. SAKAMOTO, K. SATO, F. ONO, H. TAMURA, and A. MORO (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 175-182. refs

Copyright

The combustion performance of tripropellants consisting of LOX/hydrogen fuels and solid metals is investigated. Thermochemical calculations are performed to evaluate specific impulse, specific density impulse, and the combustion properties of LOX/kerosene/Be, LOX/kerosene/B, LOX/kerosene/Mg, and LOX/kerosene/Al tripropellants. The calculations show that LOX/JR-1J/Be tripropellants offer the highest specific impulse: 23 addition sec of specific impulse compared to Be addition. For specific density impulse, the addition of aluminum and beryllium offers the better results. When a coaxial injector elements using O₂/RJ-1J is applied, improvement of C* efficiency is achieved by adding aluminum and approximately 100 percent efficiency is achieved over the mixture ratio of 2.6. Use of an unlike-impinging type element injector with LOX/RJ-1J/Al does not improve the C* efficiency. Significant stabilization of combustion is observed with the addition of aluminum in the type-1 injector, F-O-F triplet. C.D.

A92-53476

STUDY ON THE INDUCTION PERIOD OF HYDROCARBON FOR ALTERNATIVE ROCKET FUEL

MAKOTO GOTO and KOICHI HAYASHI (Nagoya, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 183-187. refs

Copyright

Low and intermediate temperature ignition of n-butane is studied using a tailored condition behind a reflected shock wave. The tailored condition is established with long periods of constant pressure and temperature. The fluctuation of temperature is estimated from the results of the experiment and numerical calculation. The ignition delay time for the stoichiometric mixture of n-butane and oxygen 80 percent diluted by argon with a trace amount of carbon dioxide is obtained at a wide temperature between 785 and 1485 K and pressure between 1.5 and 6.0 atm. The ignition induction time at high temperature agrees well with the data by Burcat et al. and becomes maximum at low temperature, that is, it is close to the negative temperature coefficient region. The results promise a new era of low-temperature chemistry by shock tube experiment. Author

A92-53482

STUDY ON COMPOSITE PROPELLANT CONTAINED FERRIC OXIDE

MASAHITO KOHNO (Institute of Space and Astronautical Science, Sagami, Japan), HARUKI MARUIZUMI, SHUGERU SUZUKI, MASATOSHI CHIBA (Nissan Motor Co., Ltd., Tokyo, Japan), SHINICHI MASUDA, and KAZUSHIGE KATO (Nippon Oil & Fats Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 227-231. refs

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Propellant containing rod-shaped Fe₂O₃ has been evaluated. The propellant is found to be more effective as a burning modifier than particle-shaped Fe₂O₃ and FeOOH. The propellant has good processability, good mechanical properties, is easy to handle and inexpensive. It is concluded that the propellant is very attractive for large boost rocket motors. C.D.

A92-53494

STABILIZING EFFECT OF HYDROGEN INJECTION ON LOX/KEROSENE UNSTABLE COMBUSTION

N. YATSUYANAGI, K. SATO, H. SAKAMOTO, F. ONO, and H.

TAMURA (National Aerospace Laboratory, Kakuda, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 309-315. refs
Copyright

The effect on combustion of adding hydrogen to LOX/kerosene was tested to determine if higher C^* efficiency could be attained and if the combustion could be stabilized. An increase in C^* proportional to the amount of hydrogen added was found, but the C^* efficiency was unchanged until 2 wt pct of hydrogen was added. The C^* efficiency decreased slightly when the amount of added hydrogen exceeded 2 wt pct. The stabilizing effect of the added hydrogen on combustion was apparent in the longitudinal mode of the high-frequency instability and adding hydrogen noticeably expanded the range of mixture ratios in stable operation. The LOX/kerosene combustion process can be stabilized with added hydrogen by controlling the energy release profile near the injector face. C.D.

A92-53772

LABORATORY SIMULATION OF ANTIMATTER STORAGE

SHIN SATORI, HITOSHI KUNINAKA, and KYOICHI KURIKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2261-2265. refs
Copyright

A method is proposed for the production of antimatter in the form of antihydrogen generated by recombination between positrons and antiprotons. Such antihydrogen is conceived as a basis for a highly compact and energetic power and propulsion source. A neutral antihydrogen beam is decelerated, trapped by lasers, and 'clusterized'. An account is presently given of an experimental demonstration using a laser diode and an Ar antimatter stimulant in a metastable state. O.C.

N92-32914# New Energy Development Organization, Tokyo (Japan).

NEDO ALCOHOL/BIOMASS TECHNOLOGY SUBCOMMITTEE

Oct. 1991 82 p In JAPANESE Presented at the 11th New Energy Development Organization Meeting, Tokyo, Japan, Oct. 1991
(DE92-526270; ETDE/JP-MF-92526270) Avail: CASI HC A05/MF A01

To develop technologies to produce alcohol directly from such unutilized resources as agricultural and forestry wastes, using bacteria, the alcohol/biomass technology development department at NEDO is moving forward development works on fuel alcohol technologies. The department is developing a composite methane gas manufacturing equipment using high-performance separation membranes to recover energies from organic matters contained in industrial waste waters using the latest methane fermentation process, which combines the biotechnology with the membrane separation technology. To serve for the methanol utilizing power generation technique expected to substitute the petroleum energy from its characteristics, the department is carrying out demonstration tests including conversion of fossil oil thermal generation to a methanol generation system. This paper introduces the summary of these researches presented at the 11th NEDO Subcommittee Conference (October 1991). For instance, the fuel alcohol technology development resulted in obtaining successfully excellent bacteria, and conducted the conceptual design and the comprehensive evaluations. DOE

MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

A92-14764

JAPANESE ACTIVITIES IN MICROGRAVITY SCIENCE

H. AZUMA (National Aerospace Laboratory, Tokyo, Japan) and T. NISHINAGA (Tokyo, University, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs
(IAF PAPER 91-374) Copyright

An overview of present Japanese microgravity research activities including future programs on fluid and material sciences is presented. Attention is given to experiments by sounding rockets and parabolic flights as well as ground-based research projects. R.E.P.

A92-15268

POSSIBILITY OF SYNTHESIS OF DIAMOND THIN FILM UNDER MICROGRAVITY ENVIRONMENT

YOSHIKI TAKAGI (Nishi-Tokyo University, Uenohara, Japan), SAKAE SATO, KAZUYUKI DAIGAWA, AKIRA B. SAWAOKA (Tokyo Institute of Technology, Yokohama, Japan), and LIIA L. REGEL' (AN SSSR, Institut Kosmicheskikh Issledovaniy, Moscow, USSR) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 5 p. refs
(IAF PAPER 91-382) Copyright

The feasibility of synthesizing thin diamond films under microgravity by means of CVD at low pressure is discussed. It is argued that, since thermal convection is suppressed under microgravity, diffusion becomes the main factor of material transport during the CVD process, leading to diamonds with less defects than under normal conditions. Experiments were carried out in a closed system with no gas flow, showing that, under these conditions, thin diamond films could be formed on (100) silicon substrate during a short time of reaction, but the growth could not be maintained for long periods. I.S.

A92-18483

GAAS SOLUTION GROWTH ABOARD TEXUS ROCKET

SHIGEO KODAMA, YUICHI SUZUKI (Space Technology Corp., Tokyo, Japan), OSAMU UEDA, and OSAMU OHTSUKI (Fujitsu Laboratories, Ltd., Atsugi, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 6 p. refs
(IAF PAPER 91-387) Copyright

A GaAs solution growth experiment aboard the TEXUS-19 sounding rocket was carried out as a preliminary to a projected Spacelab D-2 experiment. The phenomenological study was to explain differences in GaAs crystal growth in microgravity aboard the rocket compared to growth on the ground. Cathodoluminescence measurements indicated that the quality of crystals grown in microgravity is the same as that of 1-g reference samples with the same temperature-time profile, but worse than that of samples grown on the ground with a slower cooling rate. Thus, it is concluded that the crystal quality depended mainly on the growth conditions (cooling rate) restricted by the short microgravity duration (6 min) rather than on the effects of gravity. Consequently, to determine the advantages of a microgravity environment in growing high-quality semiconductor crystals, slow cooling, and hence a long experiment time, is required. Author

A92-27225

SOLIDIFICATION OF METALS UNDER MICROGRAVITY CONDITIONS

TETSUICHI MOTEGI (Chiba Institute of Technology, Narashino, Japan) Japan Institute of Light Metals, Journal (ISSN 0451-5994), vol. 41, Dec. 1991, p. 858-865. In Japanese. refs

The properties of metals solidification under microgravity conditions are presented, and materials test data are examined.

Cold hardening of metals and solidification of alloys are discussed. Results are presented for a number of binary aluminum alloys.

Y.P.Q.

A92-29402

CRYSTAL GROWTH OF HEN EGG-WHITE LYSOZYME USING A CRYSTALLIZATION VESSEL PRODUCED FOR A SPACELAB EXPERIMENT

SHIGEO AIBARA (Kyoto University, Uji, Japan) and YUHEI MORITA (Fuji Oil Co., Ltd., Tsukuba Research and Development Center, Japan) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 116, no. 3-4, Feb. 1992, p. 289-293. refs

Copyright

An enzyme crystallization vessel designed and produced for a spacelab experiment is used to investigate crystallization conditions of hen egg-white lysozyme (mucoprotein N-acetylmuramylhydrolase, EC 3.2.1.17) at 20 °C. Relatively large single crystals of the enzyme grew within 6 d by the batch method under the protein concentration of 28-30 mg/ml and in the limited concentration ranges of 3.2 to 3.6 percent (w/v) NaCl as the precipitant. Single crystals more than 3 mm in each dimension appeared in 3 to 4 mo under the lower protein concentration, but they had cracks when growing as large as 5 mm and were disrupted. It is suggested that the fracture of large single crystals of hen egg-white lysozyme is not affected by sodium azide. P.D.

A92-35644

STUDY ON A DROP FLOATING EXPERIMENT USING ELECTROSTATIC FLOATING EQUIPMENT

MASAAKI OGIWARA, TSUMORU FUJII, YUJI Ikegami, A. TANJI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan), MICHIO AOYAMA, and T. ODA (Nishi Nihon Institute of Technology, Fukuoka, Japan) *IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 93, 94. In Japanese.*

Floating position equipment for material tests is presented. The configurations of the electrostatic floating equipment are listed. Analysis of material tests using the electrostatic floating equipment is emphasized and test results are examined. Y.P.Q.

A92-35647

TECHNOLOGICAL DEVELOPMENT FOR AN AIRCRAFT MICROGRAVITY EXPERIMENT. I

MORIO SHIMIZU, HIDEO KIMURA, and T. KUSUNOSE (NASDA, Tokyo, Japan) *IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 99, 100. In Japanese.*

Active vibration control technology for an aircraft microgravity experiment is described. Experimental results of accelerating feedback control are given, and passive vibration control technology is addressed. Y.P.Q.

A92-38210

MATERIAL SCIENCES IN SPACE

ISAO NAKATANI (National Research Institute for Metals, Tokyo, Japan) *IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 86-90. In Japanese.*

Materials processing in the space microgravity environment is discussed. Potential applications involving crystal growth and containerless processing of materials are presented. Y.P.Q.

A92-48626

STEP MOTION OF CDI2 CRYSTALS GROWING FROM AQUEOUS SOLUTION

KAZUO ONUMA, KATSUO TSUKAMOTO (Tohoku University, Sendai, Japan), and ICHIRO SUNAGAWA (Yamanashi Institute of Gemmology and Jewelry Arts, Kofu, Japan) *Microgravity Science and Technology* (ISSN 0938-0108), vol. 5, no. 2, July 1992, p. 62-68. refs

Copyright

The advancing rates of spiral layers on the (0001) face of

cadmium iodide crystals were measured in situ as a ground based work for microgravity experiments. It was found that the step velocity depended upon time at a constant supersaturation. Unsteady state nature seen in the time sequence of step velocities was concluded to be attributed to the accumulation of iodide impurities during the step advancement. It was shown that the waiting time for the re-growth of step from the dead zone near saturation point increased with the amount of keeping time in the zone. This 'impurity effect' was less observed when acetone solution was used instead of aqueous solution. Author

A92-53751

GLASS IN MICROGRAVITY - MELTING, DEFORMATION, AND CRYSTALLIZATION

MASAKI MAKIHARA, JUNJI HAYAKAWA (Government Industrial Research Institute, Osaka, Japan), CHANDRA S. RAY, and DELBERT E. DAY (Missouri-Rolla, University, Rolla) *IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2119-2123. refs*

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The Government Industrial Research Institute, Osaka (GIRIO), is scheduled to conduct experiments on glass-forming melts aboard the Space Shuttle, in 1991. Ground-based work, along with short duration microgravity experiments, are under way at GIRIO and in collaboration with the University of Missouri-Rolla. Short-duration microgravity experiments are conducted in an aircraft flying parabolic trajectories. An acoustic levitation furnace is used to levitate and melt small spherical samples. The related ground-based work is also described. Attention is focused on the effect of surface tension and interfacial tension on the shape of glass melts under various gravity levels, ranging from 0 to 10 g. The effect of specific gravity and the weight of a glass melt were also considered. Author

A92-53761

CONTROL SYSTEM OF ELECTROSTATIC LEVITATOR

KAZUNORI Ikegami, CHIHIRO TSUKISHIMA, and SOICHIRO OKUDA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) *IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2191-2196. refs*

Copyright

A levitator is an experimental tool for creating the new materials and protein. An electrostatic levitator with high speed response has been developed and tested in terrestrial and microgravity environments. The control system developed is presently tested by considering the electric field distribution. A feedback control system for the electrostatic levitator is designed in order to stabilize the position of a material test sample. This system is applied to the ring type levitator in the terrestrial and microgravity environment. The sampling time of the feedback control system is achieved to be 8 microsec. Good controllability of the levitator is achieved in the terrestrial and microgravity experiments. A heavy aluminum sample, which cannot be levitated in terrestrial environment, is successfully levitated in a microgravity environment created by an aircraft. The control system of the electrostatic levitator can move the charged sample to another position stably. Author

A92-53763

DEVELOPMENT OF PASSIVE DAMPING SYSTEM FOR MICRO G-JITTER REDUCTION

YOSHINORI FUJIMORI, HIDEO KIMURA (NASDA, Tokyo, Japan), KAZUKI WATANABE (NEC Aerospace Systems, Ltd., Yokohama, Japan), KAZUHIRO TODOME (NEC Corp., Yokohama, Japan), JUN INAGAKI, and NAOTO TANABE (NEC Environment Engineering, Ltd., Tokyo, Japan) *IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2203-2212. refs*

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Japan's NASDA is considering a passive damping system that

29 MATERIALS PROCESSING

uses an isolator, as well as a damping joint involving a viscoelastic material, for the reduction of microgravity jitter in space experiments. High damping is required in the 10 exp -5 to 10 exp -2 range, over the 0.1-100 Hz frequency range. The test results obtained for this device show that the damping joint reduced the resonant amplification factor to 1/2 to 2/3, while the isolator reduced vibration to 1/10th at 1 Hz, in keeping with theoretical predictions. O.C.

A92-53764

STUDY OF ACTIVE VIBRATION CONTROL SYSTEM FOR IMPROVEMENT OF MICROGRAVITY ENVIRONMENT

YOSHINORI FUJIMORI, HIDEO KIMURA (NASDA, Tokyo, Japan), KOUJI TANIDA (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan), and SEIKO HOSHI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2213-2218.

Copyright

An active vibration control system is being developed to improve microgravity environments for experimental uses; the system will isolate outer vibration disturbances above cutoff frequency while holding the experimental payload at a neutral position against the rack, below the cutoff frequency. Electromagnetic suspensions are used as the vibration-isolating element of the system; it is to these suspensions that control signals are delivered. There are six controllable degrees of freedom for the system. O.C.

A92-53769

EM PHASE DEVELOPMENT OF ISOTHERMAL HEATING FURNACE ONBOARD SFU

TAKASHI KANAKUBO, NOBUO HAMANO (Hitachi, Ltd., Space System Div., Yokohama, Japan), and NOBORU WAKASUGI (Institute for Unmanned Space Experiments Free Flyer, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2243-2247. Research supported by MITI and New Energy and Industrial Technology Development Organization.

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The development of the Isothermal Heating Furnace (IHF) for the Space Flyer Unit (SFU) is now in its EM phase. During this phase, detailed design and its verification plan have been established. IHF has a multifurnace configuration, and it is capable of accommodating up to ten furnaces with any combination of high temperature furnaces (gas quenching available) and low temperature furnaces. Analysis and tests are being carried out in an effort to verify the design. In this paper, descriptions of the IHF subsystem and its major components are given, along with some of the results of an analysis. Author

A92-53770

THE DEVELOPMENT OF SFU EXPERIMENT EQUIPMENT

NOBORU WAKASUGI, KENICHIRO TANI, and HIROSHI MASHIMA (Ishikawajima-Harima Heavy Industries Co., Ltd., Space Development Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2249-2254.

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Japan's Space Flyer Unit will carry a gradient heating furnace (GHF) and a mirror heating furnace (MHF) for semiconductor crystal-growing experiments. An account is given of the developmental problems faced by this experimental apparatus' designers. The GHF furnace has three temperature sections in order to furnish the temperature gradient required for the horizontal Bridgman crystal growth method. The MHF can accomplish containerless melting, and is preferred for refractory material crystal growth. O.C.

A92-57312

DEVELOPMENT OF ELECTROPHORESIS UNIT

T. OKUSAWA, Y. KOJIMA, K. TSUBOUCHI, A. ASHIDA, N. HAMANO, and Y. TAKAGI (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 9 p. refs (IAF PAPER 92-0949) Copyright

The paper presents the features of our electrophoresis unit, including its cooling system with SiC ceramics chamber wall and thermo-module, multi-channel fractioning system with piezo-electric micropump, and degassing system applying electromagnetic force as the bubble driving force. In addition, results of the experiments on the ground are presented. The ground experiments confirmed that the cooling system could control temperatures on the chamber wall surface within +/- 0.5 C. The piezoelectric micropump could successfully work to reach 18 kPa in the delivery pressure and 2.5 ml/min in the discharge. The electromagnetic force could remarkably promote degassing on its principle. Author

N92-22091# National Space Development Agency, Tokyo (Japan). Space Experiment Group.

DEVELOPMENT OF FMPT (FUWATTO 1991)

NORIO SOICHI *In its* Preprints of NASDA's 5th Technical Symposium p 31-63 1 Jun. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

The First Material Processing Test (FMPT) is Japan's first experience in conducting manned space experiments. Twenty-two material science experiments and twelve life science experiments were selected and have been developed for the flight using the Space Shuttle/Spacelab module. Major instrument systems have been developed by the National Space Development Agency of Japan (NASDA) and will be installed in three double racks. The Shuttle, on which a Japanese Payload Specialist (PS) will conduct experiments for the first time with some American crew members, is scheduled to be launched on 17 Jun. 1991. Experiments and flight hardwares are fully developed, and FMPT seems to be a good example and precedent for future space environment utilization. Author (NASDA)

N92-23635*# National Space Development Agency, Tokyo (Japan).

ORGANIC CRYSTAL GROWTH EXPERIMENT FACILITY (13-IML-1)

AKIO KANBAYASHI *In* NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 225-229 Feb. 1992

Avail: CASI HC A01/MF A03

The interesting nature of metal-like organic compounds composed of charge transfer complexes has been recently realized. Crystals of these complexes can usually be grown by the solution crystallization method. It is difficult to grow such organic crystals on Earth, especially from the chemical reactions through diffusion controlled process in the solutions, because of gravitational disturbances, or sedimentation. The International Microgravity Lab. (IML-1) Organic Crystal Growth with G-Gitter Preventive Measure (OCGP) experiment is expected to grow a single crystal large enough to allow its intrinsic physical properties to be measured and its detailed crystal structure to be determined. This experiment also attempts to assess the experimental conditions including the microgravity environment for further study of the fundamental process of solution crystallization, nucleation, and growth from supersaturated phases including chemical reactions. Microgravity disturbances, G-jitter, may be an important environmental factor in the experimental method to assess. The vibration damping effects on organic crystal growth can be carefully studied. Author

N92-26440# National Space Development Agency, Tokyo (Japan).

PARABOLIC FLIGHT: REPORTS OF MICROGRAVITY EXPERIMENTS BY AIRCRAFT, VOLUME 1, NO. 2

21 Aug. 1991 86 p In JAPANESE

(EG-910045; JTN-92-80348) Avail: CASI HC A05/MF A01

Microgravity experiments that were carried out in aircraft are

reported. The following topics are discussed: parabolic flight, microgravity, low gravity manufacturing, space processing, plasma processing, plasma behavior, plasma diagnostics, gravitational effects, bubble migration, bubble movement, vapor/liquid reorientation, liquid-vapor interface, liquid stability in containers, biomedical data acquisition, biological effects, and containerless melts.

Author (NASDA)

N92-26441# Diamond Air Service, Inc. (Japan). Flight Operations.

OUTLINES OF PARABOLIC FLIGHT (PARABORIKKU FURAITO NI TSUITE)

TAROU KAGEYAMA *In* NASDA, Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 1-9 21 Aug. 1991 *In* JAPANESE

Avail: CASI HC A02/MF A01

Microgravity experiments that utilize the parabolic flight path of aircraft are outlined. Among the topics discussed are the following: the underlying principles, normal parabolic flight patterns, flight restrictions, the level of microgravity produced, and the flight duration. Two of the main advantages that microgravity flight experiments provide, are cost effectiveness and a wide range of available gravity levels.

Author (NASDA)

N92-26442# National Space Development Agency, Tokyo (Japan).

PRELIMINARY EXPERIMENT OF GDEF (GAS DYNAMICS EXPERIMENT FACILITY)

KIWAU SHIBUKAWA (National Space Development Agency, Ibaraki (Japan).), KEIJI MURAKAMI (National Space Development Agency, Ibaraki (Japan).), SHINICHI KAMEI (National Space Development Agency, Ibaraki (Japan).), MASAMICHI ISHIKAWA (National Space Development Agency, Ibaraki (Japan).), NOBUHIRO OOTA (National Space Development Agency, Ibaraki (Japan).), NAOJI FUJIMORI (National Space Development Agency, Ibaraki (Japan).), TADAO INUZUKA (National Space Development Agency, Ibaraki (Japan).), and YUICHIROU SATOU (National Inst. for Research in Inorganic Materials, Ibaraki, Japan) *In its* Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 10-19 21 Aug. 1991 *In* JAPANESE

Avail: CASI HC A02/MF A01

An experimental study of gravitational effects on the convection and the behavior of plasma in the CVD (Chemical Vapor Deposition) process is performed using the MU-300 airplane. This experiment is conducted as a preliminary study for the SFU (Space Flyer Unit) GDEF (Gas Dynamics Experiment Facility) mission. The visualization of gas flow at low pressure shows that the thermal convection of He is eliminated in the microgravity condition. A temperature fluctuation in the gas is observed in microgravity. It is synchronized with the G-jitter. This effect can not be observed in 1- and 2-G conditions. The characteristic of plasma is somewhat different between micro- and 1-G conditions. It is not difficult to ignite the plasma in micro-G. An experiment using methane hydrogen mixed gas, which will be used in GDEF mission, is planned in the next year.

Author (NASDA)

N92-26443# National Space Development Agency, Tokyo (Japan).

PARABOLIC FLIGHT EXPERIMENTS ON BUBBLE MIGRATION UNDER REDUCED GRAVITY

SUSUMU YOSHITOMI (National Space Development Agency, Ibaraki (Japan).), MINORU NAKI (National Space Development Agency, Ibaraki (Japan).), HIROTO SAMEJIMA (National Space Development Agency, Ibaraki (Japan).), MASARU OYAMA (National Space Development Agency, Ibaraki (Japan).), SEIZOU ISHIKURA (National Space Development Agency, Ibaraki (Japan).), MASAMICHI ISHIKAWA (National Space Development Agency, Ibaraki (Japan).), SHINYA ISHII (National Space Development Agency, Ibaraki (Japan).), TOSHIKAZU GOSHOZONO (National Space Development Agency, Ibaraki (Japan).), and HIROAKI MATSUMOTO (Mitsubishi Heavy Industries Ltd., Tokyo, Japan) *In its* Parabolic Flight: Reports of Microgravity Experiments by

Aircraft, Vol. 1, No. 2, p 20-26 21 Aug. 1991 *In* JAPANESE *In* JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A01

Bubble migration in a rectangular fluid container was studied, while undergoing parabolic flight. The two mechanisms that cause bubble movement are considered: impulsive shaking of the fluid container and the acoustic radiation pressure gradient. Bubble movement toward the acoustic pressure node was observed in the latter case. The resulting translational velocity is approximately 2 mm/sec. In this experiment, the piezo-electric shaker, acoustic transducer, and the automatic bubble injection system functioned well. The bubble radii ranged in size from 0 to 1.5 mm due to a constant piston insertion. This is because of an excess pressure head during the entry phase of a micro-G flight and a capillary effect inside of the injection needle. These experimental results will be used to improve the equipment that will be employed in the upcoming TR-1A (Test Rocket-1A) sounding rocket missions experiments.

Author (NASDA)

N92-26444# National Space Development Agency, Ibaraki (Japan).

MICRO-GRAVITY EXPERIMENT OF VAPOR/LIQUID REORIENTATION INDUCED BY CAPILLARY FORCE

MASAO FURUKAWA (National Space Development Agency, Ibaraki (Japan).), YASUO ISHII (National Space Development Agency, Ibaraki (Japan).), YOSHIROU MIYAZAKI (National Space Development Agency, Ibaraki (Japan).), TOORU IIDA (National Space Development Agency, Ibaraki (Japan).), TSUTOMU YAMAZAKI (National Space Development Agency, Ibaraki (Japan).), KEIJI MURATA (National Space Development Agency, Ibaraki (Japan).), MINORU KOMORI (National Space Development Agency, Ibaraki (Japan).), and YOSHIO KURIYAMA (Toshiba Corp., Tokyo, Japan) *In its* Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 27-35 21 Aug. 1991 *In* JAPANESE

Avail: CASI HC A02/MF A01

The purpose of this experiment is to establish the concept of liquid reorientation and transfer under micro-gravity conditions. This is important for component design in the development of the Two-Phase Fluid Loop Thermal Management System, especially in terms of the accumulator and the reservoir design. Although it is known that liquid reorientation is achieved via capillary force (surface tension), the design parameters such as capillary core structure, wall material, and treatment are not well understood. In order to support the design, a model for an aircraft test was prepared. This model is composed of a copper container, a polycarbonate window, a copper core, and it uses water. The copper surfaces are treated to improve their wettability. Due to this design, water flows to the core in the microgravity regime due to capillary force and/or surface tension. Six types of core shape (core plate) are tested to determine the following: (1) acceleration direction before micro-gravity condition; (2) the water quantity; and (3) the existence of non-condensable gases. It is confirmed that core shape is most dominant for liquid reorientation, i.e., it is observed that, as the core angle is made larger and as the average core separation (equivalent to capillary gap) is made smaller, the liquid reorients to the core more easily and the vapor reorients to the outside of the core.

Author (NASDA)

N92-26445# National Space Development Agency, Tokyo (Japan).

LIQUID MOTION ANALYSIS WITH LATERAL IMPACTS UNDER LOW GRAVITY

MORIO SHIMIZU (National Space Development Agency, Ibaraki (Japan).), SHUNJI NAGAOKA (National Space Development Agency, Ibaraki (Japan).), RON USAMI (National Space Development Agency, Ibaraki (Japan).), TSUNEO OKUYAMA (National Space Development Agency, Ibaraki (Japan).), MUNEO TAKAOKI (National Space Development Agency, Ibaraki (Japan).), KAZUhide KAMIMURA (National Space Development Agency, Ibaraki (Japan).), YOSHIO KOBAYASHI (National Space Development Agency, Ibaraki (Japan).), MASARU OYAMA (National Space Development Agency, Ibaraki (Japan).),

29 MATERIALS PROCESSING

MASAHIRO FUKUI (National Space Development Agency, Ibaraki (Japan).), and SEIZOU ISHIKURA (Japan Space Utilization Promotion Center, Tokyo.) *In its Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 36-50* 21 Aug. 1991 In JAPANESE
Avail: CASI HC A03/MF A01

The stability of liquid in cylindrical containers was studied under low gravity induced by parabolic flight. An aim of this experiment is to evaluate handling methodology for biological solutions in microgravity. Glass or acrylic cylinders with 3.4 to 20 mm inner diameters were half filled with physiological saline or 70 percent ethanol solution. The in-flight measurements were made by observing the sloshing induced by lateral impacts in a range of 0.1 G to 1.0 G. This level is equivalent to the magnitude of acceleration caused by casual human handling. The liquid (water) surface remained stable, during the parabolic flight, in the tubes with diameters smaller than 7 mm. The tubes smaller than 5 mm in diameter remained stable during the impact even under the microgravity. The sloshing in microgravity, after the impact, was more remarkable in larger tubes. The surface tension appeared to be the major stabilizing force that kept the liquid contained. This experiment suggested that the handling of small amounts of aqueous solutions may be performed in microgravity with an apparatus similar to laboratory equipment such as pipettes and small test tubes.
Author (NASDA)

N92-26446# National Space Development Agency, Tokyo (Japan). Space Experiment Group.

BIOMEDICAL DATA ACQUISITION AND PROCESSING TECHNOLOGY

SHUNJI NAGAOKA (National Space Development Agency, Ibaraki (Japan).), AKIRA MIYAMOTO (National Space Development Agency, Ibaraki (Japan).), MORIO SHIMIZU (National Space Development Agency, Ibaraki (Japan).), SATORU WATANABE (National Space Development Agency, Ibaraki (Japan).), SAYUMI KANEKO (National Space Development Agency, Ibaraki (Japan).), KEISUKE SUZUKI (National Space Development Agency, Ibaraki (Japan).), SHIROU USUI (National Space Development Agency, Ibaraki (Japan).), MASAKI KAMIYAMA (National Space Development Agency, Ibaraki (Japan).), YUTAKA HIRATA (Toyohashi Univ. of Technology, Aichi, Japan), TEIRYOU KOJIMA et al. *In its Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 51-64* 21 Aug. 1991 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A01

A parabolic flight experiment that investigated biomedical data acquisition from a human subject was performed. Six flights consisting of 9 to 11 parabolas per flight were successively performed using two different flight protocols, normal (2.3 G) and reduced (1.3 G) accelerations. A wide variety of fundamental physiological signals, such as Electro-Cardiogram (ECG), Galvanic Skin Reflex (GSR), respirogram, digital volume pulse wave, Blood Pressure (BP), Electro-Oculo-Gram (EOG), cardiac output, body temperature, percutaneous partial pressures of oxygen, and carbon dioxide, were simultaneously acquired during the flights. The signals were recorded from a healthy male subject under controlled posture, respiration rate, and field darkness. Of the signals acquired, the GSR, cardiac parameters and respirogram were found to be sensitively correlated to the acceleration environment, especially to the reduced gravity phase. The EOG also showed clear vertical nystagmus, after the gravity truncation, in an upright posture. All collected data was digitized and processed to be formatted to MS-DOS files (360 M Byte). All of the processed data was compiled in a small database system which enables one to search and manage such a large volume of data with ease. The use of sophisticated digital signal processing techniques is discussed in terms of the software environment for the analytical support of the user.
Author (NASDA)

N92-26447# National Space Development Agency, Tokyo (Japan).

THE EXPERIMENT UNDER MICROGRAVITY BY AIRCRAFT: THE EXPERIMENT IN FLOATING BY GAS FLOW

SUSUMU YOSHITOMI (National Space Development Agency, Ibaraki (Japan).), MINORU NAKI (National Space Development Agency, Ibaraki (Japan).), HIROTO SAMEJIMA (National Space Development Agency, Ibaraki (Japan).), TSUNEO MACHIDA (National Space Development Agency, Ibaraki (Japan).), KIYOSHI TANAKA (National Space Development Agency, Ibaraki (Japan).), SHIN NAKAMURA (National Space Development Agency, Ibaraki (Japan).), KAZUKO ISHIKAWA (National Space Development Agency, Ibaraki (Japan).), and JUNJI HAYAKAWA (Government Industrial Research Inst., Osaka, Japan) *In its Parabolic Flight: Reports of Microgravity Experiments by Aircraft, Vol. 1, No. 2, p 65-74* 21 Aug. 1991 In JAPANESE
Avail: CASI HC A02/MF A01

When materials melt and then solidify in the furnace, they gain impurities from the touching surface. It is important that materials are melted and solidified without physical contact. Equipment that uses a constant supply of Helium gas to float sample materials was tested during the parabolic flight of an aircraft. The results indicate that the sample materials could be successfully suspended between the nozzles.
Author (NASDA)

N92-28441*# National Space Development Agency, Tokyo (Japan).

NASDA'S ACTIVITIES ON VIBRATION ISOLATION TECHNOLOGY

In NASA. Lewis Research Center, International Workshop on Vibration Isolation Technology for Microgravity Science Applications p 175-192 May 1992 Prepared in cooperation with Japan Space Utilization Promotion Center, Tokyo, Japan; Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan; and Nippon Electric Co., Tokyo, Japan
Avail: CASI HC A03/MF A04

The National Space Development Agency's (NASDA) activities in providing various vibration isolation technologies for the Space Station Mission are covered in viewgraph form. Technologies covered include an active vibration isolation system for extra sensitive missions in the low frequency range, a passive damping system consisting of a damping rack for the reduction of resonance amplification, and an isolator for vibration isolation from low frequencies. Information is given in viewgraph form on the active vibration isolation concept, voice coil type electromagnetic suspension, a profile of an active vibration isolation system, a three degree of freedom ground experiment, and acceleration feedback.
Author

N92-33512# Space Technology Corp., Tokyo (Japan).

DETERMINING THE THERMAL CONDUCTIVITY OF MOLTEN INSB

T. HIBIYA, F. YAMAMOTO, S. NAKAMURA, and T. YOKOTA *In ESA, Sounding Rocket Experiments in Fluid Science and Materials Sciences: TEXUS 21 to 24 and MASER 3* p 88-91 Mar. 1992 Copyright Avail: CASI HC A01/MF A02; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

Precise measurement of thermal conductivity of molten semiconductors was undertaken under microgravity conditions using the TEXUS rocket. For measurement purposes the time controlled wire method was chosen. The measurement principle and apparatus are described. An increase in the temperature of the wire as measured on Earth and also under microgravity conditions was observed. There was shown to be a linear relationship between the temperature rise and the logarithm of time under microgravity conditions. On Earth in contrast, deviation from the linear relationship was observed. The thermal conductivity of molten InSb under microgravity conditions is almost constant: 15.8 W/m-K (at 830 K) and 18.2 W/m-K (at 890 K). On Earth the thermal conductivity values appears to increase with time. The measurement of thermal conductivity shows that under microgravity conditions the thermal conductivity of molten semiconductors can be precisely determined.
ESA

ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

A92-13346

HE II FLOW PHENOMENA THROUGH FOUNTAIN EFFECT PUMP ELEMENT

TETSUYA HANYU, AKIHIRO NAKANO, and MASAHIDE MURAKAMI (Tsukuba, University, Japan) IN: Advances in cryogenic engineering. Vol. 35A - Proceedings of the 1989 Cryogenic Engineering Conference, Los Angeles, CA, July 24-28, 1989. New York, Plenum Press, 1990, p. 231-238. refs

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The He II flow through a porous medium for a fountain effect pump is investigated experimentally, in particular in superfluid turbulent flow situation, and a computer program is constructed for predicting the pump performance in these situations. Four porous elements are tested, two of which have small enough permeabilities to be regarded as ideal superleaks. It is found that, for small flow rates, the superfluid He II flows ideally through a porous element and that the London (1939) equation is valid. The He II velocity through a porous element reaches a maximum value with respect to the heater power; the maximum decreases nonlinearly with the decrease of the element thickness. In the superfluid turbulent region, the effective flow passage concept gives satisfactory estimates of the flow rate. I.S.

A92-13347

MEASUREMENTS OF THE CRITICAL VELOCITY OF HYDRAULIC CAVITATION IN SUPERFLUID HE-4

K. NISHIGAKI and M. TAKEDA (Kobe University of Mercantile Marine, Japan) IN: Advances in cryogenic engineering. Vol. 35A - Proceedings of the 1989 Cryogenic Engineering Conference, Los Angeles, CA, July 24-28, 1989. New York, Plenum Press, 1990, p. 239-245. refs

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In an effort to clarify the mechanism of the inception of phase transition in liquid helium, He II was made to cavitate in the flow through a glass constriction nozzle with a diameter of 0.45 mm, by using a fountain effect pump. Attainable critical velocities for incipient cavitation were obtained over a temperature range of 1.2 K to the lambda-point. It was found that the cavitation threshold was quite low, with an approximate range of 0.1 - 1.0 KPa. The result seems to show that, contrary to the hypothesis of nuclear bubbles, some kind of direct coupling between the state of flow of He II, probably superfluid turbulence, and the inception of cavitation may be responsible for the phenomena. Author

A92-13349

THERMAL DESIGN AND TEST OF IRTS CRYOSTAT

M. MURAKAMI (Tsukuba, University, Japan), G. FUJII, T. HASUI, K. HAMA, T. MACHIDA (NEC Corp., Space Development Div., Yokohama, Japan), M. KYOYA, M. HIRABAYASHI (Sumitomo Heavy Industries, Ltd., Toyo, Japan), H. OKUDA (Institute of Space and Astronautical Science, Sagami, Japan), and T. MATSUMOTO (Nagoya University, Japan) IN: Advances in cryogenic engineering. Vol. 35A - Proceedings of the 1989 Cryogenic Engineering Conference, Los Angeles, CA, July 24-28, 1989. New York, Plenum Press, 1990, p. 295-302. refs

Copyright

The cryostat designed for the Infrared Telescope in Space (IRTS), which will be launched on board the Space Flyer Unit in 1994, is described. The cryostat is capable of cooling down the IRTS to 1.8 K by stored superfluid He for about one month, making it possible for IRTS to carry out astrophysical observations even in the FIR region. Results are presented of a thermal design study for the cryostat system with the main goal of minimizing the heat

leak to the He II temperature level for the maximum life time.

I.S.

A92-13389

HELIUM LIQUEFACTION BY A GIFFORD-MCMAHON CYCLE CRYOCOOLER

MASASHI NAGAO, TAKASHI INAGUCHI, HIDETO YOSHIMURO, TADATOSHI YAMADA, and MASATAMI IWAMOTO (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IN: Advances in cryogenic engineering. Vol. 35B - Proceedings of the 1989 Cryogenic Engineering Conference, Los Angeles, CA, July 24-28, 1989. New York, Plenum Press, 1990, p. 1251-1260. refs

Copyright

This paper describes the principal design features and performance test results of a three-stage Gifford-McMahon cycle cryocooler which has achieved a no-load temperature of 3.3 K and succeeded in helium liquefaction. The key point of the success is the selection of Gd(x)Er(1-x)Rh compounds as a regenerator material. The refrigeration capacity was 20 mW at 4.2 K, and the helium liquefaction rate was 10 cu cm/h. Author

A92-13390

HIGH EFFICIENT TWO-STAGE GM REFRIGERATOR WITH MAGNETIC MATERIAL IN THE LIQUID HELIUM TEMPERATURE REGION

T. KURIYAMA, R. HAKAMADA, H. NAKAGOME (Toshiba Corp., Toshiba Research and Development Center, Ukishima, Japan), Y. TOKAI, M. SAHASHI (Toshiba Corp., Toshiba Research and Technology Center, Komukai, Japan), R. LI, O. YOSHIDA, K. MATSUMOTO, and T. HASHIMOTO (Tokyo Institute of Technology, Japan) IN: Advances in cryogenic engineering. Vol. 35B - Proceedings of the 1989 Cryogenic Engineering Conference, Los Angeles, CA, July 24-28, 1989. New York, Plenum Press, 1990, p. 1261-1269. refs

Copyright

This paper describes experimental results obtained from a two-stage Gifford-McMahon (GM) refrigerator which uses a rare earth compound as a 2nd regenerator matrix instead of a Pb matrix. The refrigeration capacity below 10 K for a conventional two-stage GM refrigerator is so small that the lowest temperature achieved is limited to the 8 K level. The purpose of this study is to improve the refrigeration performance in the temperature region below 10 K. The technical point is to use Er₃Ni as a 2nd stage regenerator matrix, because it has much larger volumetric specific heat than Pb below 15 K and has almost the same specific heat as Pb at higher temperature. The reciprocating speed was optimized to improve the refrigeration performance. Refrigeration capacity of 1 W at 6.59 K and no load temperature of 4.50 K were obtained from the Er₃Ni regenerator. The refrigeration loss mechanism below 10 K is also discussed. Author

A92-21721

PAR-WIG PERFORMANCE PREDICTION DURING ACCELERATION FROM WATER-BORNE TO AIR-BORNE

SHIGENORI ANDO (Tokushima Bunri University, Japan) and MICHIO KATO (Nagoya University, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, Nov. 1991, p. 139-152. refs

Take-off performance is calculated for PAR-WIG which utilizes propeller-slipstream. For this purpose, a quick automatic computation scheme is developed for performance of 'engine-propeller combination system'. Example calculations are presented, which show that the hump drag is completely removed with PAR effect. It is noted that variable-geometry of wing-end-plates is desirable and variable-camber of main-wing is essential. Author

A92-25505

A QUICK AUTOMATIC METHOD FOR COMPUTING PERFORMANCE OF NONDUCTED PROPELLER WITH CONSTANT-REVOLUTIONAL-SPEED

31 ENGINEERING (GENERAL)

SHIGENORI ANDO and MICHIO KATO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 455, 1991, p. 675-679. In Japanese. refs

A quick automatic method is presented for computing performance of a nonducted propeller with constant rotational speed. This study is motivated by its usefulness for developing WIG vehicles, namely in order to predict propeller data to be used. Results of computation examples show that constant-speed propellers are considerably robust, viz. insensitive to change of some parameters such as diameter, solidity, and rotational speed. It is noteworthy that these well-known properties are confirmed easily and quickly by the present method. Author

A92-26724

PREPARATION OF A TIC SINGLE CRYSTAL BY THE FLOATING-ZONE METHOD FROM A SELF-COMBUSTION ROD
SHIGEKI OTANI, TAKAHO TANAKA, and YOSHIO ISHIZAWA (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN: Combustion and plasma synthesis of high-temperature materials. New York, VCH Publishers, 1990, p. 322-327. refs
Copyright

A92-30052

THERMOMECHANICAL FLOW OF HE II THROUGH A POROUS ELEMENT FOR A FOUNTAIN EFFECT PUMP
M. MURAKAMI and T. HANYU (Tsukuba, University, Japan) Cryogenics (ISSN 0011-2275), vol. 32, no. 4, 1992, p. 371-378. Research supported by MOESC. refs
Copyright

The thermomechanical flow of He II through a porous element for a fountain effect pump was experimentally investigated to understand the general flow characteristics in both ideal and turbulent flow states. The flow rate increases in proportion to the heat input Q in the ideal superfluid flow state for small Q , but it tends to saturate for further increases of Q in the superfluid turbulent state, and finally reaches a maximum at the He II temperature in the downstream region just below T_{λ} . The flow in the latter state is found to be well formulated in terms of the Gorter-Mellink mutual friction term if it is modified to take account of the interior structure for flow passages in an element. The modified formulation clearly models the existence of the maximum flow rate and a geometrical similarity law for the flow rate. A computer simulation was also successfully attempted to predict the flow characteristics through a fountain effect pump element. Author

A92-35623

EFFICIENT METHOD OF DESIGN FOR MULTIFLEXIBLE SYSTEMS USING EQUATIONS OF MOTION

Y. MORITA (Institute of Space and Astronautical Science, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 41, 42. In Japanese.

Computational simulations for a space experiment described. The equations of motion are used for an efficient design method for multiflexible systems. Mathematical models for the multiflexible systems are calculated. Y.P.Q.

A92-40874

BOND GRAPH MODELLING OF MULTIBODY DYNAMICS AND ITS SYMBOLIC SCHEME

TAKEHIKO KAWASE and HIROAKI YOSHIMURA (Waseda University, Tokyo, Japan) Franklin Institute, Journal (ISSN 0016-0032), vol. 328, no. 5-6, 1991, p. 917-940. refs
Copyright

A bond graph method of modeling multibody dynamics is demonstrated. Specifically, a symbolic generation scheme which fully utilizes the bond graph information is presented. It is also demonstrated that structural understanding and representation in bond graph theory is quite powerful for the modeling of such large scale systems, and that the nonenergetic multiport of junction structure, which is a multiport expression of the system structure, plays an important role, as first suggested by Paynter. The principal

part of the proposed symbolic scheme, that is, the elimination of excess variables, is done through tearing and interconnection in the sense of Kron using newly defined causal and causal coefficient arrays. Author

A92-42399

FORMATION OF MICROCRATERS BY BOMBARDMENT OF MICROCLUSTERS

ITSUO KATAKUSE (Osaka University, Toyonaka, Japan), SHUN'ICHI BABA (Okayama Ceramic Center, Bizen, Japan), TOSHIO ICHIHARA, and MOTOJI IKEYA (Osaka University, Toyonaka, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1245-1247. Research supported by Matsuo Foundation and Nissan Science Foundation. refs

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Nanometer-size impact microcraters similar in shape to the submicron craters on lunar samples have been produced on a graphite surface by the bombardment of energetic microclusters of CsI and Au, and have been observed by a scanning tunneling microscope. The dependence of the crater diameter on the mass and energy of the projectiles is within the range of the extrapolated line obtained from massive projectiles. Impact craters generated on a plastic track detector can also be optically detected with enlargement by chemical etching. Author

A92-43240

THE MANEUVER PERFORMANCE AND CONTROL OF A HOVERCRAFT

N. KAWABATA and Y. MIURA (Nihon University, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 624-627. In Japanese. refs

The model configurations of a radio controlled hovercraft is presented. The improvement of the stability and control system and maneuver performance is discussed. Y.P.Q.

A92-43245

CAM RESEARCH FOR SHEET METAL SECTIONS

A. HIDA (Japan Aircraft Corp., Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 644-647. In Japanese.

Computer program development for sheet metal section automation is described. A test model is given and an operational evaluation of a flat pattern is presented. Y.P.Q.

A92-44341

LIQUID CRYSTAL LARGE SCREEN PROJECTION DISPLAYS

AKIHIRO MOCHIZUKI, YASUHIRO YONEDA, and TOSHIKI NARUSAWA (Fujitsu Laboratories, Ltd., Atsugi, Japan) Fujitsu Scientific & Technical Journal (ISSN 0016-2523), vol. 28, no. 1, Spring 1992, p. 1-12. refs

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A liquid crystal large screen projection display for presentations is reviewed. Two types of addressing mode, an optically addressed and an electrically addressed projection display are introduced. Several types of electrically addressed liquid crystals are possible for the presentation device. Those currently available include the supertwisted nematic (STN) and nematic-cholesteric phase transition (NCPT) liquid crystal projectors. The applications of these for a still image display device are compared. Author

A92-53525

EXPERIMENTAL STUDY OF AIR MASS EFFECT

SHUN-ICHI ODA and YOSHITSUGU YASUI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 551-556. refs

Copyright

An experimental investigation in a vacuum chamber has been conducted to confirm and quantify the air mass effect on space

structures. A theoretical equation derived by Lamb (1921) expressing the ratio of the resonant frequency in a vacuum to that in air is confirmed, and the free-free disk parameters are determined. It is shown that the air mass effect can be computed with sufficient accuracy using the virtual mass method. C.D.

A92-56034

GUST RESPONSE AND CROSS WIND PERFORMANCE OF A HOVERCRAFT WITH VERTICAL WINGS

NAGAKATU KAWAHATA (Nihon University, Tokyo, Japan) and YOSHIHIRO MIURA (Olympos Co., Ltd., Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 138-141. In Japanese. refs

The configurations of a radio-controlled hovercraft model with vertical wings are presented. The flight performance in cross wind is evaluated, and the difference between the target point and visual angular error is addressed. Y.P.Q.

A92-56035

ON THE MANEUVERING TESTS OF AN ACV MODEL

RINICHI MURAO (Aoyama Gakuin University, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 142-145. In Japanese. refs

Results of an ACV simulation to investigate control response, ice surface friction, and wind direction and speed are presented. Test methods are given, and position and yaw measurements are addressed. Y.P.Q.

A92-56036

CONFIGURATION OF FLEXIBLE-SKIRTS FOR AN ACV AND ITS CAD

RINICHI MURAO and MINORU IWAI (Aoyama Gakuin University, Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 146-149. In Japanese. refs

An investigation of the flight performance and durability of an ACV is presented. Designs of various flexible skirts for ACV are examined. Geometric and dynamic conditions are given for the computer-aided design of an ACV. Y.P.Q.

A92-56037

SEAL SYSTEM OF A LARGE SURFACE EFFECT SHIP

Y. TOYAMA, S. ONO, and S. NISHIHARA (MES, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 150-153. In Japanese.

This paper focuses on the most suitable selection of seal system for a large SES with a length of more than 60 m. Several types of seal systems were studied, conducting tank tests, air inflating tests and numerical structural analysis. The flexible membrane seal is most promising if the material has high resistance to flex-fatigue and abrasion. The wear life of the membrane can be evaluated by using a test rig called an air flagellator. Author

A92-56038

PLANNING METHOD OF SKIRT SYSTEMS FOR SMALL ACVS

KENSUKE MATSUO (Kumamoto Institute of Technology, Japan) and HIDEO MATSUO (Kumamoto University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 154-157. In Japanese. refs

A simple method to predict the static configuration of the skirt is proposed. Effects of the weight of skirt material and the pressure distribution in the nozzle region are considered. The nozzle region is the space between the ground and the skirt. The numerical results are shown and discussed. Both the effects of the weight of skirt material and the pressure distribution in the nozzle region are important for the initial design of a bag-type skirt. Author

N92-15204# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

A NEW TYPE OF LIQUID: HE-3 TARGET SYSTEM USING SMALL MECHANICAL REFRIGERATORS

S. KATO, K. KOBAYASHI, K. MARUYAMA, H. OKUNO, O. KONNO, T. SUDA, T. MAKI, H. ASAMI, and T. KOIZUMI Apr. 1991 17 p

(DE91-508414; INS-870) Avail: CASI HC A03/MF A01

A new type of liquid He-3 target has been developed for photoabsorption experiments at intermediate energies. Using the cooling power of liquid He-4 at reduced vapor, He-3 gas is liquefied into a cylindrical target cell of 180 ml and is maintained at 2.0 K during the experiment. Evaporated He-4 gas is evacuated by a rotary pump and returned into the He-4 bath in the cryostat, where two small mechanical refrigerators with cooling capacities of 3 W at 4.3 K and 10 W at 20 K are operated for the purpose of He-4 recondensation. A maintenance-free operation of more than 1,000 hours has become possible by adopting the He-4 circulation system. DOE

N92-17757# National Aerospace Lab., Tokyo (Japan). Thermofluid Dynamics Div.

DISCUSSION FOR POSSIBILITY OF SOME AERODYNAMIC GROUND EFFECT CRAFT [ARU AERODAINAMIKKU GURAUNDO IFEKUTO KURAFUTO NO KANOSEI NIKANSURU ICHI KOSATSU]

YOSHIKAZU TANABE May 1990 32 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-619; JTN-92-80290) Avail: CASI HC A03/MF A01

Some type of pleasant, convenient, safe, and economical transportation method to supplement airplane transportation is currently required. This paper proposes an Aerodynamic Ground Effect Craft (AGEC) as this new transportation method, and studies its qualitative feasibility in comparison with present typical transportation methods such as transporter airplanes, flying boats, and linear motor cars which also have common characteristics of ultra low altitude cruising. Noteworthy points of AGEC are the effective energy consumption against transportation capacity (exergie) and the ultra low altitude cruising, which is relatively safer at the emergency landing than the subsonic airplane's body landing. Through AGEC has shorter cruising range and smaller transportation capacity, its transportation efficiency is superior to that of airplanes and linear motor cars. There is no critical difficulty in large sizing of AGEC, and AGEC is thought to be the very probable candidate which can supplement airplane transportation in the near future. Author (NASDA)

N92-18036# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

EFFECTIVE CLEANING OF OIL-PROTECTED BEARING STEEL EXAMINED BY XPS ANALYSIS. PART 2: LOW POLLUTION CLEANING

MAKOTO NISHIMURA (Mitsubishi Heavy Industries Ltd., Tokyo (Japan).), MASAMI MINAMI (Mitsubishi Heavy Industries Ltd., Tokyo (Japan).), and AKIHIKO MATSUI (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan) Apr. 1991 13 p In JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1104) Avail: CASI HC A03/MF A01

A cleaning procedure for ball bearings was developed which has a low possibility for environmental pollution. Both a commercially-available synthetic detergent and a potassium fatty acid (27 percent solution) were tested to determine their ability to clean bearing balls protected by an anti-rust oil containing barium sulfonate and zinc sulfonate. Results were compared. An X-ray photoelectron spectroscopy (XPS) analysis was performed to evaluate their effectiveness. Results showed that a synthetic detergent ultrasonic cleaning followed by an ethanol completely cleaned a mirror-finished surface, but not a turned one (Rmax: 20 microns). It was additionally determined that the potassium fatty acid solution exhibited superior cleaning capability when compared with organic solvents, including trichloroethylene, although the

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potassium fatty acid solution was inferior to the alkaline detergents. Author

N92-33778# Nippon Electric Co. Ltd., Tokyo (Japan).
CONSTRUCTION OF MANNED LUNAR SURFACE SITES BY ROBOTS [ROBOTTO NI YORU YUJIN GETSUMEN KYOTEN NO KOUCHIKU]
TOSHIKI OKUDAIRA, KAZUhide TODOME, and JUNKO TAKAHASHI (Nippon Electric Co. Ltd., Japan) / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 19 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

Manned lunar surface site is the smallest manned system for staying, constructed on lunar surface prior to constructing permanent lunar bases with minimum function. This report describes the results of reviews on initial construction, system setting up, and lunar surface operation robots required most critically for those activities. Functional requirements for manned lunar surface sites are described. Lunar surface site construction by robots are outlined. System structure, weight and electric power balances, and construction flow are also outlined.

Author (NASDA)

N92-33779# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
CONSTRUCTION OF MANNED LUNAR SURFACE SITES [YUJIN GETSUMEN KYOTEN NO KOUCHIKU]
YOSHINORI YUZAWA, MICHIO HORIE, TETSUYA NAKAMURA, RITA AMAGATA, and TETSUYA HONDA / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 21 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

A review is conducted on manned lunar surface sites to be constructed in around 2010 to conduct various experiments and observations on the lunar surface in a short time prior to developing permanent lunar bases. Methods of construction and operation of manned lunar surface sites are established, taking requirements from the mission parts and shipping mean constraints. Review results of mission requirements and operation profiles are presented. Experiment subjects, structures and outlines of subsystems, weight balance, electric power balance and functional block diagram of the manned lunar surface sites are presented. Conceptual drawings of air-lock and roving vehicle, operation profiles and conceptual drawing of lunar surface sites are shown.

Author (NASDA)

N92-33784# Obayashi Corp., Tokyo (Japan).
PRODUCTION OF CONSTRUCTION MATERIALS FOR LUNAR BASES Report No. 1 [GETSUMEN KICHI NO TAME NO KENSETSU ZAIRYOU NO SEISAKU]
YUJI ISHIKAWA, TETSUMI HIGASAYAMA, TETSUO SASAKI, YUKIO SHIMIZU (Tokyo Univ., Japan), and KYOICHI KURIKI (Tokyo Univ., Japan) / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 16 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

Research was conducted to verify what construction materials can be produced on the lunar or Mars surface. Soil simulation of lunar or Mars surfaces is produced, and heating and melting experiments by microwave are conducted. Experiment equipment consisting of a microwave generator, power monitor, crucibles, and thermometer are outlined. Experiment parameters, measured temperatures, and melting and radiation energy obtained by calculations are presented. Block production experiments by cold pressing are also conducted. Experiment equipment, material composition conditions, and the results of experiments are outlined. Block production using microwave heating is compared with other production techniques. The possibility of producing construction materials from soils on lunar or Mars surfaces was verified, and it was suggested that they can be used for constructing structures on lunar or Mars surfaces. Author (NASDA)

N92-33785# Shimizu Corp. (Japan).
STRUCTURES AND CONSTRUCTION OF NUCLEAR POWER PLANTS ON LUNAR SURFACE [GETSUMEN NI OKERU GENSHI RO TATEYA NO KOUZOU TO SEKOU]
KATSUNORI SHIMIZU, MASUHIKO KOBATAKE, SACHIO OGAWA, HIROSHI KANAMORI, YASUHIKO OKADA, HIDEYUKI MANO, and KENJI TAKAGI / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

The best structure and construction techniques of nuclear power plants in the severe environments on the lunar surface are studied. Facility construction types (functional conditions such as stable structure, shield thickness, maintainability, safety distances, and service life), construction conditions (such as construction methods, construction equipment, number of personnel, time required for construction, external power supply, and required transportation) and construction feasibility (construction method, reactor transportation between the moon and the earth, ground excavation for installation, loading and unloading, transportation, and installation, filling up the ground, electric power supply of plant S (300 kW class) and plant L (3000 kW class)) are outlined. Items to pay attention to in construction are (1) automation and robotization of construction; (2) cost reduction by multi functional robots; and (3) methods of supplying power to robots. A precast concrete block manufacturing plant is also outlined.

Author (NASDA)

N92-33786# Takenaka Works, Osaka (Japan). Technical Research Lab.
EXPERIMENTAL STUDY ON LUNAR UNDERGROUND BASE CONSTRUCTION BY GAS BALLOON METHOD [GASU BARUN KOUHOU NI YORU GETSUMEN CHIKA KICHI NO KENSETSU HOUHOU NO JIKKEN TEKI KENTOU]
TOSHIO SAITOU, TAKATOSHI OGAWA, KATSUTOSHI ASAI, and YASUSHI NAKAYAMA / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 9 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A02/MF A10

The pressure forming property of superplastic alloys expected to be of practical use as materials for gas balloon method is studied. Results of reviews on pressure forming property and application to the gas balloon method of superplastic alloys, and experiment plans for formulating spaces in environments simulating those in the lunar underground are outlined. The following topics are described: (1) fundamental concept of gas balloon method; (2) method to evaluate the workability of superplastic alloys; (3) effects of pressure control accuracy on the workability of superplastic alloys; and (4) an example of pressure and temperature control pattern for dome formation with superplastic alloys.

Author (NASDA)

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COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

A92-10740
SPATIAL AND FREQUENCY DOMAIN INTERFEROMETRY USING THE MU RADAR - A TUTORIAL AND RECENT DEVELOPMENTS

SHOICHIRO FUKAO and ROBERT D. PALMER (Kyoto University, Uji, Japan) / Journal of Geomagnetism and Geoelectricity (ISSN 0022-1392), vol. 43, no. 8, 1991, p. 645-666. refs
Copyright

Fundamental notions of spatial and frequency-domain interferometry are reviewed, and a novel method is proposed for steering the antenna beam after the data are stored. Also presented

is a comparison of techniques for wind-vector determination with emphasis given to a method based on the linear variation of the phase of the cross-spectra. Recent applications of spatial interferometry (SI) and frequency-domain interferometry (FDI) are listed including an implementation of FDI with MU radar. The vertical wind velocity estimated from the Doppler technique is shown to be a measure of the wind perpendicular to tilted refractivity surfaces. The bias generated by horizontal wind is found to have a significant effect on the Doppler estimate in SI. The use of MU radar in FDI can facilitate measurements of the positions of high reflectivity layers smaller than the resolution volume. C.C.S.

A92-13677

PLANE WAVE DIFFRACTION BY A FINITE SINUSOIDAL GRATING

KAZUYA KOBAYASHI and TORU EIZAWA (Chuo University, Tokyo, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Sept. 1991, p. 2815-2826. refs
Copyright

The diffraction of a plane electromagnetic wave by a perfectly-conducting finite sinusoidal grating is analyzed using the Wiener-Hopf technique combined with the perturbation method. Assuming the depth of the grating to be small compared with the wavelength and approximating the boundary condition on the grating surface, the problem is reduced to that of the diffraction by a flat strip with a certain mixed boundary condition. Introducing a perturbation expansion for the unknown scattered field under the small-depth approximation, the problem is formulated in terms of the zero order and the first order Wiener-Hopf equations, which are solved exactly in a formal sense by a factorization and decomposition procedure. Applying a rigorous asymptotics, explicit high-frequency asymptotic solutions are further obtained for the width of the grating large compared with the wavelength. Scattered far field expressions are derived by taking the inverse Fourier transform and applying the saddle point method. Representative numerical examples of the far field patterns are given for various physical parameters, and the scattering characteristics of the grating are discussed. Author

A92-13678

NUMERICAL ANALYSIS OF ELECTROMAGNETIC WAVE SCATTERING FROM AN INDENTED BODY OF REVOLUTION

HIROYOSHI IKUNO, MICHIZOH GONDOH, and MASAHIKO NISHIMOTO (Kumamoto University, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Sept. 1991, p. 2855-2863. refs
Copyright

Electromagnetic wave scattering from a perfectly conducting indented body of revolution is analyzed both in the frequency and time domains. The three-dimensional (3D) scattering process and the effect of polarization on scattering characteristics are revealed. A well-defined scattering matrix representation is adopted for investigating the polarimetric property of the 3D scattering. First, the scattering cross sections are calculated in the frequency domain by using the Yasuura method (Mode-Matching Method) which is a powerful and reliable numerical method for solving electromagnetic boundary value problems. Next, co-polarization and cross-polarization components of the pulse response waveforms are calculated from the scattering matrix by using the Fourier synthesis technique. It is found out from the numerical results that the pulse responses from the indented objects can be interpreted as three distinctive waves: conventional specularly-reflected wave, creeping wave and complex specularly-reflected wave which is reflected from a complex specular reflection point. These scattering processes are consistently explained by employing the extended ray theory. And the radar polarimetries of these three distinctive waves are clearly observed both in co-polarization and cross-polarization components of scattering cross sections and pulse responses. Author

A92-13679

ONE-DIMENSIONAL RADAR TARGET IMAGING OF LOSSY DIELECTRIC BODIES OF REVOLUTION

TORU UNO, SABURO ADACHI (Tohoku University, Sendai, Japan),

and YOSHIYUKI MIKI (Toyota Motor Corp., Higashifuji Technical Center, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Sept. 1991, p. 2915-2921. refs
Copyright

This paper discusses on the methods and their numerical simulation results of the 1D profiling of dielectric targets in the direction of electromagnetic wave incidence. Two different inverse profiling algorithms are proposed. The first method is based on the Rayleigh approximation. The inverse profiling is carried out by performing the Fourier transformation of the backscattered field in frequency domain. In this method, the dielectric constant of the target is assumed as known beforehand. The second method is based on the extended physical optics (EPO) method. The EPO method was proposed for calculating the backscattering cross section for a conducting scatterer; however, the EPO method is applied to the inverse problem of the dielectric target whose dielectric constant is not known. The validity and limitation of each method are tested numerically for spherical and spheroidal targets. Author

A92-16322

AN IMPROVEMENT OF PARASITIC DIPOLE ARRAY USING SUPPRESSOR ELEMENTS

AGUS HARTANTO and TSUTOMU SUZUKI (University of Electro-Communications, Chofu, Japan) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 39, Sept. 1991, p. 1434-1436. refs
Copyright

A novel configuration of parasitic arrays is introduced. The characteristics of the array in both forward and backward radiation are improved by using a new element, the suppressor. The suppressor elements are aligned parallel to a radiating dipole or to a conventional endfire array such as a Yagi-Uda array. Radiation in the unwanted direction is reduced by the suppressors, and the forward gain is effectively increased. Design of the optimum antenna parameters was achieved using the moment method, and results were compared to measured values, with good agreement obtained. New arrays were compared to well-designed Yagi-Uda arrays. A new array which is aligned with two broadside suppressors and with three endfire elements had an improved forward gain of 1.5 dB and a reduced backward gain of -4 dB compared to a conventional, well designed Yagi-Uda array with five endfire elements. I.E.

A92-18167

A COMPARISON OF VHF RADAR VERTICAL-VELOCITY MEASUREMENTS BY A DIRECT VERTICAL-BEAM METHOD AND BY A VAD TECHNIQUE

M. F. LARSEN, S. FUKAO, O. ARUGA, M. D. YAMANAKA, T. TSUDA, and S. KATO (Kyoto University, Japan) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 8, Dec. 1991, p. 766-776. Research supported by MOESC. refs
(Contract F49620-88-C-0121)
Copyright

Vertical-velocity measurements made by a direct vertical-beam method are compared to vertical velocities derived from VAD (velocity-azimuth display) measurements over a 27-h period. The results indicate that the two types of measurements in regions where the scatter is isotropic agree well. The largest discrepancies occur in the regions characterized by strong stratification and anisotropic or aspect-sensitive scatter. Although there are various assumptions inherent in the VAD calculations of the vertical velocities, indications are that the source of error is the aspect sensitivity, which produces effective off-vertical pointing angles in the vertical beam when the refractivity layers are tilted out of the horizontal plane. However, other additional sources of bias or error cannot be excluded. Author

A92-18173

THREE-DIMENSIONAL DISPLAY OF RADAR ECHOES USING THE TECHNIQUE OF MARCHING CUBES

YASUSHI FUJIYOSHI, MASAYUKI OHI, and GOROW WAKAHAMA (Hokkaido University, Sapporo, Japan) Journal of Atmospheric

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and Oceanic Technology (ISSN 0739-0572), vol. 8, Dec. 1991, p. 869-872. refs
Copyright

Three-dimensional (3D) displays of meteorological radar echoes are presented. Surfaces of precipitating clouds were specified by some echo intensity (dBZ) by the marching cubes method, which is a high-resolution 3D surface construction algorithm. Surfaces of radar echoes look like 'real' surfaces of clouds and give a good insight into their 3D configuration. Author

A92-18486

X-BAND CAPABILITY OF USUDA DSN STATION AND ITS APPLICATION TO FUTURE MISSIONS

TOMONAO HAYASHI, TOSHIMITSU NISHIMURA, HARUTO HIROSAWA, MITSURU ICHIKAWA, and ZEN-ICHI YAMAMOTO (Institute of Space and Astronautical Science, Sagami, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs
(IAF PAPER 91-451) Copyright

A92-18510

A STUDY ON EXPERIMENTAL COMMUNICATIONS SYSTEM USING MICROSATELLITES

RYUTARO SUZUKI, RYU MIURA, KIMIO KONDO, TAKASHI IIDA, TOMOKI OBUCHI (Communications Research Laboratory, Koganei, Japan), OSAMU NAKAGAWA, MASAYASU MATSUI, and NOBORU MURANAKA (NEC Corp., Yokohama, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p.
(IAF PAPER 91-499) Copyright

This paper describes a study on experimental communication system using microsattellites. The communication network system consists of a few microsattellites and provides an information network system which picks up and delivers voice, correspondence, diagram and some digital information from/to ground station, and/or from/to satellite. The ground-station radio link is 9.6 kbps, and the inter-satellite radio link is 1 kbps. The microsattellite has a very unique feature with twin twenty-six-hedron structure connected to each other by an expanded mast. The total weight of the satellite is 50 kg. Author

A92-18513

A STUDY ON THE 22 GHZ-BAND SATELLITE BROADCASTING SYSTEM OF THE FUTURE

YASUHIRO AOKI, YUICHI OTSU, TETSUO YAMAMOTO, and KIYOSHI MOMOTA (Space Communications Research Corp., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs
(IAF PAPER 91-503) Copyright

This paper describes a study of the mission requirements and system concept for future DBS (Direct Broadcasting Satellite) using the 22 GHz band, and a 22 GHz band DBS system. An antenna-feed system that compensates for rain attenuation is proposed, and the development status of 22 GHz band high power TWT is discussed. Author

A92-18514

BROADBAND ISDN SATELLITE COMMUNICATIONS SYSTEM CONSIDERATIONS

MAKOTO KAWAI, KENJI NAKAYA, KAZUYASU OKADA, Y. MOTOYAMA, and M. KOBAYASHI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 6 p. refs
(IAF PAPER 91-504) Copyright

Research and development for Broadband ISDN (B-ISDN) is being intensively promoted as a network expected to be the primary telecommunications network currently evolving toward the next century. Satellite communications are expected to play an effective part in B-ISDN by taking advantage of their characteristics in the following applications: (1) the network can be extended promptly to wide areas at the initial introduction stage; (2) the services can be provided to regionally isolated areas promptly and economically;

and (3) the terrestrial network can be employed more efficiently by allocating uncertain traffic demand and traffic variations between relay nodes to satellite communications. Author

A92-18518

TDMA SATELLITE COMMUNICATION SYSTEMS FOR ISDN SERVICES

MASAHIRO MORIKURA, SHUJI KUBOTA, KIYOSHI ENOMOTO, and SHUZO KATO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 6 p. refs
(IAF PAPER 91-508) Copyright

This paper proposes a TDMA (time division multiple access) satellite communication system suitable for ISDN services covering both basic interface and primary interface services. The proposed system provides B-channel transmission lines among highest hierarchy telephone offices and subscriber lines for basic and primary interface services. To provide these services economically and efficiently, the proposed system employs demand assignment technology for each data burst and a transmitting and receiving transponder (carrier) hopping TDMA scheme which is the most sophisticated hopping scheme ever utilized. Author

A92-18527

JAPANESE ACTIVITIES FOR PAN-PACIFIC INFORMATION NETWORK USING A SATELLITE

TAKASHI IIDA, KIMIO KONDO (Communications Research Laboratory, Tokyo, Japan), YOSHIKI NEMOTO (Tohoku University, Sendai, Japan), and MASATOMO TANAKA (University of Electro-Communications, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. Research supported by Okawa Institute of Information and Telecommunication, Research and Development Center for Radio Systems, and KDD Engineering and Consultants. refs
(IAF PAPER 91-520) Copyright

The Pan-Pacific Information Network is a nonprofit satellite communication system along the same concept as PEACESAT of the University of Hawaii. The project of the Pan-Pacific Information Network was proposed at the Pacific ISY Conference and now this is one of the ISY projects, named PEACESAT Expansion/Pan-Pacific Information Network, in the ISY Space and Education Working Group. SAFISY Panel of Experts on Education and Applications. The immediate goal is to construct the satellite network using simple earth stations at low cost for mutual communication and information exchange in the fields of education, research and health in the Pacific region. This paper describes the study status of the network and the related activities in Japan. Ideas to help realize this network include: (1) a satellite hitchhiker payload, and (2) preparation of the earth station by volunteer groups to allow low cost. Author

A92-19130

VEHICLE ANTENNAS FOR MOBILE SATELLITE COMMUNICATIONS

SHINGO OHMORI (Communications Research Laboratory, Koganei, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3210-3221. refs
Copyright

Research on and the state of the art of vehicle antennas for mobile satellite communications are reviewed. Particular attention is given to the concept of mobile satellite communication; system requirements for vehicle antennas; antenna systems for communications, navigation, and broadcasting; and future prospects of vehicle antennas. A monolithic microwave integrated circuit active phased array antenna is considered to be a key technology in the future mobile satellite communications. O.G.

A92-19131

A WIDE BEAMWIDTH AND BROAD BANDWIDTH MICROSTRIP ANTENNA WITH A PAIR OF SHORT CIRCUIT PATCHES

YOSHIO EBINE (NTT, Mobile Communications Div., Yokosuka, Japan), TOHRU MATSUOKA, and MASAHIRO KARIKOMI (Nihon

Dengyo Kosaku Co., Ltd., Tokyo, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3241-3245. refs
Copyright

A wide beamwidth and broad bandwidth microstrip antenna is presented. It consists of a rectangular patch antenna and a pair of parasitic short circuit patches placed over the radiating edges of the rectangular patch. The parasitic element not only widens the bandwidth of the antenna but also forms a narrowed pair of radiating edges, so the E-plane beamwidth becomes broader. An antenna trial model achieved a bandwidth of 16 percent and a broad E-plane beamwidth of 165 deg. Author

A92-19132

CIRCULARLY POLARIZED CONICAL BEAM FORMATION BY BACKFIRE HELICAL ANTENNAS

HISAMATSU NAKANO, YASUO SAURA, HIROAKI MIMAKI, and JUNJI YAMAUCHI (Hosei University, Koganei, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3246-3252. refs
Copyright

A backfire helical antenna (BHA) is numerically analyzed to form a circularly polarized conical beam. The conical beam whose radiation is null in the helical axis direction is obtained using a second-mode operation of the BHA. The characteristics of monofilar, bifilar, and quadrifilar BHAs are compared and discussed. It is found that the second-mode bifilar BHA radiates a circularly polarized conical beam over a frequency range of 1:1.4. The use of the first mode of a bifilar BHA is also investigated to form a quasi-conical beam which has the weak radiation in the helical axis direction. Author

A92-19133

RADIATION CHARACTERISTICS OF SHORT BACKFIRE ANTENNA APPLICABLE TO MOBILE COMMUNICATIONS

KAZUNORI TAKEUCHI (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan), TAKAYASU SHIOKAWA (Kokusai Denshin Denwa Co., Ltd., Research and Development Laboratories, Kamifukuoka, Japan), and MASAYUKI YASUNAGA (Kokusai Denshin Denwa Co., Ltd., Tokyo, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3253-3260. refs
Copyright

A numerical analysis of the short backfire antenna (SBA) is performed using the method of moments with the wire-grid model. The radiation characteristics of this antenna, including the radiation pattern and the antenna gain, are clarified. Comparisons with measured data were carried out, and good agreement was obtained. It is pointed out that the theoretical approach presented here can be used to optimize the performance characteristics of the SBF antenna. L.M.

A92-19134

A TWO-LAYER SELF-DIPLEXING ANTENNA USING A CIRCULARLY POLARIZED RING PATCH ANTENNA

WATARU CHUJO, MASAYUKI FUJISE (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan), MASAYUKI NAKANO, HIROYUKI ARAI (Yokohama National University, Japan), and NAOHISA GOTO (Tokyo Institute of Technology, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3261-3267. refs
Copyright

This paper presents a newly developed two-layer self-diplexing antenna for mobile satellite communications with mutual coupling suppression between transmitting and receiving antenna. The self-diplexing antenna is composed of circular microstrip and ring patches. Numerical results based on an electromotive force method using boundary admittance are compared with experimental results. The numerical results significantly agree with the experimental results. The experiments show that the total isolation between transmitting and receiving antennas is more than 35 dB. Author

A92-19135

A CIRCULARLY POLARIZED SLOT-COUPLED MICROSTRIP ANTENNA USING A PARASITICALLY EXCITED SLOT

HIROKI SHOKI, KAZUAKI KAWABATA, and HISAO IWASAKI (Toshiba Corp., Research and Development Center, Kawasaki, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3268-3273. refs
Copyright

The authors propose a new circular polarization method for a slot-coupled microstrip antenna. An antenna of simple configuration in which a parasitically excited slot exists in addition to a directly excited slot generates circular polarization by the effect of higher order modes. Experimental results and numerical results using the spatial network method are described to verify the performance and consider the circular polarization generating mechanism. Author

A92-19136

A CIRCULAR MICROSTRIP ANTENNA WITH A CROSS SLOT FOR CIRCULAR POLARIZATION

HISAO IWASAKI and KAZUAKI KAWABATA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3274-3279. refs
Copyright

A new circularly polarized microstrip antenna fed by a cross slot using an aperture coupled feed is proposed. The proposed antenna has no 90 deg hybrid coupler for circular polarization and allows easy connection to microwave devices for electronic beam scanning. In this paper, the conditions for circular polarization in this new antenna are derived, and the measured results are also described to verify the authors' proposed conditions for circular polarization. Good return loss and axial ratio characteristics have been obtained. Author

A92-19137

A FADING REDUCTION TECHNIQUE USING INTERLEAVE-AIDED OPEN LOOP SPACE DIVERSITY FOR DIGITAL MARITIME-SATELLITE COMMUNICATIONS

HISATO IWAI, YOSHIO KARASAWA (Kokusai Denshin Denwa Co., Ltd., Research and Development Laboratories, Kamifukuoka, Japan), and MASAYUKI YASUNAGA (Kokusai Denshin Denwa Co., Ltd., Tokyo, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3286-3294. refs
Copyright

In maritime satellite communications particularly for low G/T earth stations, multipath fading becomes a serious problem, especially at low elevation angles. A new fading reduction scheme for sea surface reflection is applied to INMARSAT-C system. This method using open-loop-controlled diversity combined with an FEC and an interleaver overcomes the disadvantages generally associated with a conventional diversity system. This method has a respectable fading reduction effect, moreover, it can shorten the interleave length. These effects of the system are evaluated by a computer simulation and its performance is discussed. This fading reduction technique can be applied not only to the INMARSAT-C but also to any kind of digital communication system where interleave, FEC, and diversity can be used. Author

A92-19139

SCATTERING OF ELECTROMAGNETIC WAVE BY DOUBLE GRATING LOADED WITH THREE-LAYERED DIELECTRIC SLABS

TAKEAKI NODA, KAZUNORI UCHIDA, and TOSHIKI MATSUNAGA (Fukuoka Institute of Technology, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3342-3351. refs
Copyright

This paper deals with electromagnetic wave scattering by an infinite plane metallic double grating with three dielectric layers in case of E- and H-waves excitations. Field expressions for this problem are obtained by making use of superposition of the results of the single grating case. The analytical method used here is

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based on the spectral domain method combined with the sampling theorem. Some numerical results are presented for the near fields such as the surface current distributions on the strips and for the far fields such as the frequency characteristics as well as the insertion loss from the viewpoint of a polarization discriminator.

Author

A92-19971

THE DEVELOPMENT OF SATELLITE BROADCASTING IN JAPAN

YUSUKE TAKAHASHI (Japan Broadcasting Corp., Tokyo) Space Communications (ISSN 0924-8625), vol. 8, Nov. 1991, p. 375-387.

Copyright

Recent advances in DBS and satellite service are examined with respect to the primary technological program developed to address the problems of reception and multichannel broadcasting. The BS-3 was recently launched to succeed the BS-2 and incorporates 3 channels, increased transponder output with 120 W, and a lifetime of 7 years. A supplementary satellite is described that is planned to serve as a back-up and provide transmission in the event of technical difficulties. Other aspects of the DBS industry are delineated including the subscription structure, the emergence of commercial broadcasting, and the incorporation of HDTV broadcasting and 8-channel satellites. Industry shifts are examined and include the transition to satellite subscriptions, the trend toward smaller antennas, and the attempt to mitigate the negative effects of adjacent 'spillover' regions.

C.C.S.

A92-21975

DIGITAL SIGNAL PROCESSING USING FUZZY CLUSTERING

KAORU ARAKAWA (Meiji University, Kawasaki, Japan) and YASUHIKO ARAKAWA (Tokyo, University, Japan) (Institute of Electronics, Information and Communication Engineers, Symposium on Digital Signal Processing, 5th, Hakone, Japan, Nov. 16, 17, 1990) IEICE Transactions (ISSN 0917-1673), vol. E74, Nov. 1991, p. 3554-3558. refs

Copyright

A novel digital signal processing technique fuzzy filtering is proposed for estimating nonstationary signals with ambiguous changes, which are contaminated by additive white Gaussian noises. In this filter, fuzzy clustering is utilized for classifying signal components into groups in which the signal characteristics are considered to be similar. Since the boundary between the signal groups is ambiguous, the fuzzy clustering produces a better effect than crisp clustering. Moreover, robust characteristics are obtained for various values of the parameters and types of processed signals. Computer simulations successfully demonstrate its superior capability of filtering.

Author

A92-25802

MULTI-H PHASE-CODED MODULATION

IWAO SASASE and SHINSAKU MORI (Keio University, Tokyo, Japan) IEEE Communications Magazine (ISSN 0163-6804), vol. 29, Dec. 1991, p. 46-56. refs

Copyright

An overview of some recent results for multi-h phase-coded modulation (MHPM) schemes is provided. These schemes offer power and bandwidth efficiency where time-varying modulation indices are used. Following a brief description of the structure of MHPM, its fundamental properties (e.g., minimum Euclidean distance and power spectra) are described. Decoding and demodulation of MHPM also are discussed, and some results on synchronization are summarized. MHPM combined with convolutional codes, asymmetric modulation indices, or nonuniform mapping are investigated.

I.E.

A92-26776

ETS-V/EMSS MOBILE SATELLITE COMMUNICATION EXPERIMENTS

KIMIO KONDO and SHINGO OHMORI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 3-9. In Japanese. refs

With the launch of ETS-V in August 1987, the Experimental Mobile Satellite System (EMSS) was developed. Several types of mobile satellite communication experiments are performed including: (1) a training ship with a 40-cm JSBF antenna for ship experiments; (2) aircraft experiments a Boeing 747 cargo aircraft with a 16-element phased-array antenna; and (3) the ACSSB, QPSK, or spread-spectrum modems employed as land mobile terminals. Experiments with a train and a portable message communicator were also performed. International cooperative experiments in land mobile-satellite communications with AUSSAT are also mentioned. The results and future plans of ETS-V mobile communication experiments are reviewed.

Author

A92-26777

DESIGN OF TRANSPONDER ON BOARD ETS-V

YUKIO HASHIMOTO, NAOKAZU HAMAMOTO, KIMIO KONDO, AKIRA ISHIDE, and TAKAO ANZAI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 11-17. In Japanese. refs

Engineering Test Satellite V (ETS-V) was launched by Japan in 1987. A communication transponder called AMEX (Aeronautical Maritime Experimental Transponder) is on board ETS-V and is to be used in mobile communication experiments. This article describes the design, functions and characteristics of AMEX/ETS-V. Sufficient performance and good adaptability for the ETS-V satellite bus has been confirmed.

Author

A92-26778

CHARACTERISTICS OF AERONAUTICAL MARITIME EXPERIMENTAL TRANSPONDER ON ETS-V

SEIJI MARUYAMA, FUMIO KAWAMATA, YUKIO HASHIMOTO, MAKOTO SAKASAI, YOSHIHIRO HASE, and NAOKAZU HAMAMOTO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 19-26. In Japanese. refs

L-band and C-band transponders onboard the ETS-V, which are used for mobile-satellite communication experiments, are called Aeronautical Maritime Experimental Transponders (AMEX). The initial check-out was conducted just after launching the satellite, and regular check-outs are carried out periodically. The precise characteristics of the AMEX are described which are obtained from the data of the initial and regular check-outs. Good performance of the AMEX is confirmed by check-out data.

Author

A92-26779

EXPERIMENTS ON AERONAUTICAL SATELLITE COMMUNICATIONS USING ETS-V

SHINGO OHMORI, YOSHIHIRO HASE, HIROMITSU WAKANA, SHINICHI TAIRA, and TOSHIYUKI IDE Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 27-37. In Japanese. refs

Experiments are performed on aeronautical satellite communications using a commercial aircraft over transoceanic flight routes. The satellite is the ETS-V which was launched on the geostationary orbit of 150 deg E. Characteristics of an airborne antenna are found to be the most important function, which is closely related to such factors as the G/T, effects of fading, and beam-scanning errors. The results are described of fading, bit-error rates, channel interference, and other important results.

Author

A92-26781

EXPERIMENTS ON MARITIME SATELLITE COMMUNICATIONS USING ETS-V

TETSUSHI Ikegami, HIROMITSU WAKANA, FUMIO KAWAMATA, TOSHIYUKI IDE, and YASUSHI MATSUMOTO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 47-56. In Japanese. refs

Mobile Satellite Communication Systems with small mobile earth stations have been studied by many organizations for establishing general mobile satellite systems which include land, maritime and aeronautical mobile users. Communications Research Laboratory has been making researches in a digital mobile satellite

communication system for small vessels and developing a small ship earth station with a 40 cm antenna. On-board experiments of the ship earth station are performed using ETS-V satellite in the Indian, North Pacific and South Pacific Ocean regions. The outline of the experiments is described and the results are discussed concerning bit error performance, fading due to sea-surface reflection, the fading reduction technique, shadowing due to ship superstructure, etc. During the experiments a stable communication link with digital telephony was successfully maintained with some effects of fading at very low elevation angles and some shadowing. Author

A92-26782

EXPERIMENTAL RESULTS OF TDM/TDMA SYSTEM VIA THE ENGINEERING TEST SATELLITE V (ETS-V)

MAKOTO SAKASAI, YOSHIYA ARAKAKI, EIHISA MORIKAWA, and YASUSHI MATSUMOTO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 57-62. In Japanese. refs

The ETS-V satellite is instrumental in the construction of the Experimental Mobile Satellite System (EMSS). Several kinds of mobile satellite communication experiments were conducted using EMSS. The simplified TDM/TDMA communication terminal equipment was used in ship experiments. This article describes the bit error rate, synchronization holding and initial acquisition characteristics resulting from these experiments. Author

A92-26783

ETS-V/EMSS MARITIME EXPERIMENTS ON DATA TRANSMISSION

NAOTO KADOWAKI and FUMIO KAWAMATA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 63-68. In Japanese. refs

In data transmission through mobile-satellite links successive frame errors cause degradation of throughput performance and increase a transmission delay. An effective error-recovery technique is necessary in order to achieve highly efficient data transmission under such conditions because many protocols are designed without taking into account unstable mobile-satellite communication links. A data-transmission experiment is performed as a part of ETS-V/EMSS maritime communication experiments to investigate frame-error characteristics. A frame format whose data field is divided into small parts called parcels is used in order to identify erroneous parts in a frame. The experimental results show that errors occur in a few parts of the frame, and the instantaneous link state in transmission can be inferred based on a received parcel-error pattern. The appropriate parcel length is estimated by the time-duration statistics of the degraded link state. Author

A92-26784

CHARACTERISTICS OF LAND MOBILE EARTH STATIONS FOR THE EMSS PROJECT

NAOKAZU HAMAMOTO, RYUTARO SUZUKI, TETSUSHI IKEGAMI, SHINICHI TAIRA, OSAMU ICHIYOSHI, NOBUYASU SATO, and SHUN-ICHI TADA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 75-82. In Japanese. refs

A feasibility study of land mobile-satellite communication was carried out using three kinds of mobile earth stations. The stations were developed after considering the potential effect of signal-propagation characteristics such as multipath fading and the blockage effect on practical applications. The first earth station employs the Amplitude-Companded SSB technique, which can transmit voice signals via narrow bandwidth. The second earth station uses a digital signal-processing technique applied to both QPSK modulation/demodulation and voice coding/decoding. The third earth station employs the spread-spectrum system using a matched-filter technique for despreading a receiving signal. This paper introduces the configurations of these earth stations and also reports on their performance. An example of signal propagation characteristics in an urban area is presented using the ETS-V satellite. Author

A92-26785

ACSSB LAND MOBILE EARTH STATION

SHINICHI TAIRA, TETSUSHI IKEGAMI, RYUTARO SUZUKI, SHOICHI SUZUKI, HIDEKI KAWAHARA, and SHUN-ICHI TADA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 83-89. In Japanese. refs

This paper describes the performance of the land mobile earth station using the Amplitude Companded Single Sideband (ACSSB) modulation technique developed for mobile satellite communications and results of the field experiments which were conducted in rural, suburban, and urban areas. This ACSSB system uses a 3-kHz pilot tone, and the voice frequency band is from 300 to 2500 Hz. The experiments show that the required C/N0 for voice communications is 40 dBHz and the required C/N0 for pilot signal tracking is 34 dBHz. Voice quality in rural and suburban areas was degraded slightly. In urban areas shadowings due to the presence of large buildings and trees caused signal losses. A comparison of the ACSSB system with the conventional narrow-band frequency-modulation system indicates that the ACSSB system can transmit voice signals more efficiently. Author

A92-26786

MULTIPLE MEDICAL DATA TRANSMISSION FROM MOBILE STATION USING ETS-V

KOICHI SHIMIZU, HAJIME MURAKAMI, KATSUYUKI YAMAMOTO, TOMOHISA MIKAMI, NOZOMU HOSHIMIYA, NAOTO KADOWAKI, and KIMIO KONDO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 105-111. In Japanese. refs

To provide emergency medicine in moving vehicles, a technique called telemedicine using mobile satellite communication was proposed. Problems were identified and solved through theoretical and numerical analyses. A system which transmits the signals of color-video, audio, 3 channels ECG and blood pressure was developed. In experiments the error characteristics of the system were measured. It was confirmed that the system works well in the range of practical C/N0. Using a satellite (ETS-V) the signals were transmitted from a navigating ship and a flying airplane to a fixed ground station. Through these analyses and experiments the effectiveness of this technique was demonstrated. Author

A92-26787

SIGNAL VARIATION IN SATELLITE COMMUNICATION LINKS

HIROMITSU WAKANA and SHINGO OHMORI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 113-118. In Japanese. refs

A large variation in the received signals from the ETS-V satellite was observed on November 30, 1989. The reason for the phenomenon is analyzed step by step to determine the causes of the signal variation. The analysis shows that the effects of the signal variation can be clearly divided into effects caused by the satellite communication system including the satellite itself and scintillations in ionosphere. The cause of signal variation is shown by the analysis to be scintillations. Author

A92-26789

A REVIEW OF MOBILE SATELLITE COMMUNICATION SYSTEMS

KIMIO KONDO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 135-143. In Japanese. refs

This article describes mobile satellite systems in the planning or development stage such as MSAT, AMSC and Geostar and mobile satellite communication experiments such as PRODAT. Studies on the system such as T-SAT are also reviewed. In addition, Japanese ETS-V and ETS-VI are described. The development of mobile-satellite communication systems is promoted along with those of communication and satellite technologies. Author

A92-26791

A SURVEY OF COMMUNICATION SATELLITE SYSTEMS USING NON-GEOSTATIONARY ORBITING SATELLITES

32 COMMUNICATIONS AND RADAR

YOSHINORI ARIMOTO, SACHIO SHIMOSEKO, and TAKASHI IIDA *Communications Research Laboratory, Review* (ISSN 0914-9279), vol. 36, no. 10, March 1990, p. 167-175. In Japanese. refs

A survey is made about research and development of communication satellite systems using non-geostationary orbiting satellites. These systems adopt specific orbits in order to optimize the system requirements. This paper summarizes developing programs in Europe and USA, such as Archimedes, Loopus, Sycomores, ACE, STET, Mailstar, MSS, and Amateur satellites.

Author

A92-26811

IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. XII - RELATIONSHIP BETWEEN VARIATIONS IN JYJ STANDARD WAVE FIELD STRENGTH AT WAKKANAI AND IONOSPHERIC PARAMETERS NEAR THE APEX

SATOSHI OKAMOTO, TAKASHI MARUYAMA, and MITSUHIRO KAMATA *Communications Research Laboratory, Review* (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 101-108. In Japanese. refs

A92-26812

IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. XIII - UNUSUAL PROPAGATIONS OF HF AND VHF RADIO WAVES

MASARU ICHINOSE and MITSUHIRO KAMATA *Communications Research Laboratory, Review* (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 109-116. In Japanese. refs

Unusual ionospheric propagations of HF and VHF radio waves associated with a geomagnetic storm during November 30 to December 1, 1988 are investigated using ionospheric data from Japan, China, and Taiwan. The increased field strength of the Japanese frequency standard signals (2.5 MHz and 5 MHz) on the night of November 30 seems to be caused by an increased MUF and/or a scattering by the disturbed ionosphere. VHF-TV radio waves propagated from China were received at Kokubunji in Tokyo. One of the most probable mechanisms explaining this unusual VHF propagation is a one-hop-F2 propagation mode which is supported by an ionosphere having anomalously high foF2. These unusual HF and VHF propagations are attributed to an unusual ionospheric condition associated with the geomagnetic disturbances.

Author

A92-29571

ADVANCED SATELLITE DIGITAL COMMUNICATION SYSTEM (SDCS-2) - EFFICIENT ACCOMMODATION OF SATELLITE CIRCUITS

HIDEMUNE SUGAHARA and YASUO MORI (NTT, Network Systems Development Center, Japan) *NTT Review* (ISSN 0915-2334), vol. 3, Nov. 1991, p. 39-44.

Copyright

NTT has developed an advanced system, SDCS-2, for satellite digital communication service. This system increases the capacity of satellite circuits in one transponder by using multicarrier time division multiple access. This paper describes an overview of the performance, configuration, and applications of this efficient SDCS-2 system.

Author

A92-29573

MOBILE RECEIVER FOR DIRECT SATELLITE BROADCASTING

KOICHI TAKANO and YASUHIRO ITOH (Japan Broadcasting Corp., Radio Engineering Research Div., Tokyo) *NHK Laboratories Note* (ISSN 0027-657X), July 1991, 8 p. refs

Copyright

A practical mobile receiver for 12 GHz direct satellite broadcasting is described. The receiver is housed in a cylindrical radome 20 cm high and 70 cm in diameter. Field tests show that this system is very practical, maintaining a reception rate of more than 90 percent on expressways.

Author

A92-29770#

A HIGHLY FLEXIBLE AND HIGHLY EFFICIENT 100W S-BAND TRANSPONDER FOR MULTIBEAM MOBILE SATELLITE COMMUNICATIONS

KOHJI HORIKAWA, MASAYOSHI TANAKA, and KAZUICHI YAMAMOTO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: *AIAA International Communication Satellite Systems Conference and Exhibit*, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 148-154. refs (AIAA PAPER 92-1823) Copyright

An S-band (2.6/2.5 GHz-band) mobile multibeam transponder is developed. This transponder has 100 W of output power. The new transponder is based on an innovative L-MPA that overcomes the main handicaps of traditional transponders. Power efficiency is improved up to twice with a new linearization technique. All signals are multiplexed and split into several signal streams of equal power. Each stream is amplified and the multiplexed signal streams are then demultiplexed and passed to the appropriate output port(s). This allows each amplifier to operate most effectively. This L-MPA transponder consumes only 1/10 power of traditional transponders. The L-MPA is so reliable that no backup units are needed. This significantly reduces component size and weight (down to 2/7). This transponder will be flight-verified in the ETS-VI program.

Author

A92-29773#

AN ADVANCED SATELLITE COMMUNICATION SYSTEM FOR ISDN SUBSCRIBER AND TRUNK APPLICATIONS - DYANET-II

TORU OTSU, MASAHIRO UMEHIRA, MASAFUMI ONUKI, and HIROSHI NAKASHIMA (NTT, Network Systems Development Center, Yokosuka, Japan) IN: *AIAA International Communication Satellite Systems Conference and Exhibit*, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 175-184. refs

(AIAA PAPER 92-1826) Copyright

This paper describes an advanced satellite communication system for ISDN subscriber and trunk applications that is integrated into a terrestrial ISDN. The system concept of DYANET (Dynamic channel Assigning and routing satellite aided digital NETWORK) has been extended to a new platform called DYANET-II which allows satellite communications to be applied to ISDN subscriber lines as well as trunk circuits. New network control technologies have been developed to achieve efficient satellite channel utilization and to ensure a single hop connection of a satellite channel without modifying existing networks. Moreover, compact earth station equipment has been newly developed for use on customer premises.

Author

A92-29798#

FIELD TESTS OF A SPREAD SPECTRUM LAND MOBILE SATELLITE COMMUNICATION SYSTEM USING ETS-V SATELLITE

TETSUSHI Ikegami, SHINICHI TAIRA, YOSHIYA ARAKAKI, and RYUTARO SUZUKI (Communications Research Laboratory, Kashima, Japan) IN: *AIAA International Communication Satellite Systems Conference and Exhibit*, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 440-445. refs (AIAA PAPER 92-1857) Copyright

The performance of a Direct Sequence Spread Spectrum Communication system in actual land mobile satellite channel is evaluated with experiments. Field test results in L-band with the ETS-V satellite are presented, in which the use of a multi-bit-quantized Coherent Matched Filter receiver improves the initial acquisition and the bit error rate performances. The BER characteristics in urban and suburban environments are found to agree with that of non-SS BPSK on a nonselective Rician fading channel.

Author

A92-29834#**A KU-BAND 4-BEAM EARTH STATION ANTENNA WITH A 6.5-M FIXED SPHERICAL REFLECTOR**

S. NOMOTO, F. WATANABE, Y. MIZUGUCHI (Kokusai Denshin Denwa Co., Ltd., Saitama, Japan), A. ABE, T. INO (NEC Corp., Yokohama, Japan), and S. OHNO (Japan Satellite Communications Network Corp., Tokyo) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 702-710. refs

(AIAA PAPER 92-1903) Copyright

A new multibeam earth station antenna has been developed to simultaneously communicate with up to four Japan's domestic communications satellites operating at Ku-band. The antenna size is 6.5 meters in physical diameter having a 5.5-meter effective aperture diameter. The main reflector, which is shared by four beams, has a spherical reflector with a circular circumference and remains stationary throughout operations. Each feed assembly has a couple of specially shaped reflectors and a corrugated horn so as to exhibit excellent electrical performances. Measurements of radiation characteristics using satellite beacon signals showed substantial agreement with the design. Author

A92-29857#**A STUDY ON A SIMPLE COMMUNICATION NETWORK BY MICROSATS**

YUKIO HASHIMOTO, RYUTARO SUZUKI, RYU MIURA, KIMIO KONDO (Communications Research Laboratory, Koganei, Japan), TOMOKI OBUCHI, KAZUYOSHI MIYAZAKI, OSAMU NAKAGAWA, MASAYASU MATSUI, and NOBORU MURANAKA (NEC Corp., Space Development Div., Yokohama, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 896-902. Research supported by Ministry of Posts and Telecommunications.

(AIAA PAPER 92-1928) Copyright

A concept for a communication network based on the use of microsatellites is advanced in which intersatellite links and onboard digital processing are featured. Voice and digital information are collected from and transferred to 9.6-kbps ground stations and a number of 1.2-kbps single-orbit LEO satellites. The orbits and constellations depend on the system objectives, but the subsystems for the microsatellite network are described in terms of the intersatellite radio link, the satellite bus system, transponder designs, and typical satellite configuration. The target performances for each system are listed including launcher options, stabilization technique, mission payloads, and antenna type. It is suggested that the microsatellite system can reduce time delay for package-message communication and confirm the validity of store and forward mail communication between ground stations and microsatellites. C.C.S.

A92-29860#**NPA'S LAND MOBILE SATELLITE COMMUNICATION EXPERIMENTS USING ETS-V**

H. SEKINE, Y. MIYATA, H. TAKUBO, and N. MURATA (Kanto Regional Police Bureau, Radio Communications Div., Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 916-926. refs

(AIAA PAPER 92-2044) Copyright

Experiments are described that were conducted to examine the effects of a mobile station environment on satellite-link quality in the context of police applications. The experimental Engineering Test Satellite V (ETS-V) is described in terms of its construction, previous implementations, and the Aeronautical Maritime Experimental mobile transponder. The ETS-V experiments are designed to assess the effects of blocking materials on received input and the effects on received input at a running mobile station in different environments. A 1545-MHz beacon is employed in

conjunction with a helical or a microstrip antenna depending on the experiment type, and it is shown that if a margin of 7 dB is attained the mobile communication link can provide satisfactory voice and data communications. It is shown that buildings or geological features can completely disrupt these communications by effectively blocking the radio-wave propagation path. C.C.S.

A92-29866#**DESIGN AND CHARACTERISTICS OF A MULTI-BAND COMMUNICATION SATELLITE ANTENNA SYSTEM**

HIROYUKI KUMAZAWA, TAKAO ITANAMI, KENJI UENO, and ISAO OHTOMO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 971-975. refs

(AIAA PAPER 92-1939) Copyright

This paper describes feasibility studies on a multiband communication satellite antenna system and the key technologies involved in devising this system. The proposed multiband communication satellite utilizes four frequency bands, Ka (30/20 GHz), Ku (14/12 GHz), C (6/4 GHz), and S (2.6/2.5 GHz) bands. It has six-beam configurations: three multibeam and three shaped-beam configurations. The following key technologies to be developed are presented: (1) low-loss frequency selective sub-reflector for compact feeds, (2) low-loss and broad-band frequency selective surface, and (3) highly accurate and reliable mesh reflector. Author

A92-29890#**ON-BOARD PROCESSING FOR DIGITAL TV TRANSMISSION**

M. SUMIYA, H. KOBAYASHI, T. MIZUNO, and Y. TAKAHASHI (Kokusai Denshin Denwa Co., Ltd., Research and Development Laboratories, Saitama, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1200-1210. Research sponsored by INTELSAT. refs

(AIAA PAPER 92-1967) Copyright

This paper is concerned with the benefit of on-board processing for future video transmission service by satellites. Various satellite system configurations of using on-board regenerator are analyzed in terms of their achievable channel capacity. The degradation of BER performance due to the nonlinearity of a satellite amplifier is considered in the link budget calculation, and many simulation runs are conducted to this end. The results of link budget calculations and discussions thereof will be presented for various combinations of multiple access methods for up and down links and of spectrum-power efficient modulation schemes, such as coded 8 phase PSK and coded 16-ary QAM, to articulate quantitatively the features and benefit of on-board processing for digital TV carrier transmission. Author

A92-29904#**MULTIPLE RESERVATION PIPE-LINE POLLING FOR SATELLITE PACKET COMMUNICATIONS**

T. OHSAWA and Y. FURUYA (NEC Corp., C&C Systems Research Laboratories, Kawasaki, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1320-1324. refs

(AIAA PAPER 92-2057) Copyright

This paper proposes a new multiple access method for satellite communications, referred to as multiple reservation pipe-line polling (MRPP). This method is able to assign channels rapidly and change the frame length according to incoming traffic. Since the proposed scheme is collision-free, it is suitable for high traffic systems, such as computer networks, compared with access methods based on slotted ALOHA. Performance analysis shows that the MRPP is superior to ALOHA or TDMA for network size of a ten to few hundred stations. Author

32 COMMUNICATIONS AND RADAR

A92-29918#

PROPAGATION IMPAIRMENT OF TDMA SATELLITE COMMUNICATION SYSTEMS AND COUNTER MEASURES

HIROSHI KAZAMA, TSUTOMU SAKAI, and SHUZO KATO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1440-1447. refs (AIAA PAPER 92-1999) Copyright

This paper describes a propagation impairment counter measure for the DYANET system which operates with a single-carrier per transponder and also proposes a transmission power control (TPC) scheme as propagation impairment counter measure for multicarrier per transponder schemes. Moreover, in order to control transmission power accurately, the Ka band rain attenuation rate is clarified. The DYANET (dynamic channel assigning and routing satellite aided digital network) system significantly reduces propagation impairment by integrating the demand assignment satellite TDMA network with the terrestrial network such that site diversity is realized without any additional transmission line. The proposed TPC scheme decreases the satellite input power error to under ± 2.5 dB. Simulation results are given that confirm the effectiveness of the TPC scheme. Author

A92-29934#

CHARACTERISTICS OF LARGE DEPLOYABLE MESH REFLECTOR ANTENNAS FOR FUTURE MOBILE COMMUNICATIONS SATELLITES

TAKASHI EBISUI, AKIO ISO, TERUAKI ORIKASA, TOSHIO SUGIMOTO, and SHIN-ICHI SATO (Space Communications Research Corp., Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1586-1592. refs (AIAA PAPER 92-2015) Copyright

A large deployable antenna is essential for effective mobile communication satellites. This paper describes the key technologies needed for such an antenna, the development plan, and the characteristics of various scale models. The electrical scale models of the mesh reflector antenna and the mechanical models of the deployable reflector have been constructed to aid in antenna design. The ultimate goal is a deployable mesh reflector antenna with 30-m diameter. The measured performance of the scale models corresponds closely to the calculated performance. These results will be extremely useful for designing large deployable mesh reflector antennas for mobile communication satellites. Author

A92-29939#

AN OPEN NETWORK TYPE DCME SYSTEM

T. KATO, K. SUGA, K. HAGI, H. OHTSUKI, M. SHINTA (NEC Corp., Overseas Transmission Div., Kawasaki, Japan), T. KINOSHITA (Miyagi NEC, Ltd., First Development Div., Kurokawa, Japan), and K. MURATA (NEC Corp., Communications Control Systems Div., Yokohama, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1629-1638. refs (AIAA PAPER 92-2021) Copyright

The first open network-type digital circuit multiplication equipment (DCME) system, which complies with Intelsat IESS-501 (Rev.2), Eutelsat BS14-49E, CCITT Rec. G.723, G.721, and Rec. Q.50 specifications, has been developed. It provides an economical way to multiply circuit capacity by using DSI and variable bit rate adaptive differential pulse code modulation techniques. It is flexible enough to support a variety of operation modes such as Multidestination for up to four destinations, Multiclique for up to two destinations, Single destination, and Mixed Single-destination and Multidestination operations. In addition, it offers a wide range of possibilities in satellite, submarine, and terrestrial applications. The newly-developed DCME system utilizes a modified adaptive

threshold activity detector and an accurate, robust data/speech discriminator in order to prevent false detection and false decisions in high background noise environment. In the DCME system, the *Operation and Maintenance Center* is used to monitor the operating conditions and to control the system functions. Author

A92-29949#

DESIGN OF A DIGITAL FM MODULATOR FOR SATELLITE BROADCASTING EARTH STATIONS

MASATOSHI HAMADA, YASUHIRO HASHIMOTO, YOSHIO TACHIOKA (Japan Broadcasting Corp., Engineering Administration Dept., Tokyo), MITSUYOSHI TSUBOIKE, ISAO IKAI, and KEN-ICHI ITOH (NEC Corp., Microwave and Satellite Communications Div., Yokohama, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1702-1713. refs

(AIAA PAPER 92-2034) Copyright

A digital FM modulator capable of generating FM waves of 140 MHz directly from digitized NTSC and MUSE signals has been developed. An adequate direct-digital synthesizer (DDS) is used together with parameters chosen to minimize the influence of spurious waves and to generate adequate FM signals. Measured data indicate that the spurious intensity is 50 dB less than the carrier level and all characteristics are consistent with the BTS specification. The digital modulator can be used together with DDS to make an earth station digitized from its studio components to its modulator. C.D.

A92-29950#

THE PERFORMANCE OF JAPANESE DIRECT BROADCASTING SATELLITE (BS-3) ON ORBIT

SHUICHI MIURA, TUNENORI AKANUMA, HARUAKI ITAGAKI, MAKOTO SASAKI, and KEIZO NAKAGAWA (NASDA, Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1714-1721. refs (AIAA PAPER 92-2035) Copyright

A review is presented of the performance of the Japanese Direct Broadcasting Satellite (BS-3), which was launched on August 25, 1991. Checkout results of the subsystems for communications, TT&C, electrical power, solar paddle, attitude, orbit control, reaction control, and thermal control are summarized. Unexpected occurrence during the BS-3a mission are discussed. C.D.

A92-29958#

A STUDY OF A CONTOURED BEAM ANTENNA FOR FUTURE JAPANESE DBS

KAZUYOSHI SHOGEN, HAYATO NISHIDA, NOBORU TOYAMA (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo), TOMOKI OBUCHI, YOSHIHIDE MIYATA, and SATOSHI MIYATANI (NEC Corp., Space Development Div., Yokohama, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1794-1802. refs

(AIAA PAPER 92-2045) Copyright

A study of contoured beam for future Japanese direct broadcasting satellites (DBS) with pattern analysis and test results for the full-scale bread board model are presented. The design of a contoured beam antenna consisting of a single offset shaped reflector and a feed horn is described as a means to optimize the radiating power for the territory. The antenna design has been conducted in the downlink frequency (12 GHz) and the analyzed radiation pattern is verified by measurement. R.E.P.

A92-29960#

A DESIGN OF AN ANTI-MULTIPATH FADING MODEM FOR MOBILE SATELLITE AND LAND MOBILE COMMUNICATION SYSTEMS

FUMIO ISHIZU, KOJI UEDA, KEISHI MURAKAMI, and TADASHI FUJINO (Mitsubishi Electric Corp., Kamakura, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1811-1818. refs
(AIAA PAPER 92-2047) Copyright

The subject addressed here is a design of an 'anti-multipath fading modem' used in Time-Division Multiple Access (TDMA) operation. The feature of this modem is an effective execution of fast burst acquisition and adaptive equalization by all digital signal processing. This modem mainly consists of a data memory and phase rotation circuit, an incoherent correlator, an adaptive equalizer and a frame synchronizer. Detailed acquisition algorithm using the incoherent correlator and the adaptive equalizer is described and performances are assessed by computer simulation and some hardware experimentation. This model is capable of executing fast acquisition and stable demodulation in the presence of a large frequency offset in severe multipath fading environment. Author

A92-29963#

THE ETS-VI SATELLITE SYSTEM AND EXPERIMENTS

HIROSHI KITAHARA, CHIKARA HARADA, YASUSHI MATSUMOTO, and YASUSHI HATO-OKA (NASDA, Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1837-1846. refs
(AIAA PAPER 92-2051) Copyright

This paper presents the characteristics of the ETS-VI system proto-flight-model (PFM) and orbital experiments of its various payloads, focusing on an intersatellite communications (ISC) experiment. The ETS-VI is a two-ton-class satellites, broadcasting satellites, and others. The satellite has 11 mission payloads. It has been shown that the satellite bus has large capability and adaptability to install many mission payloads, to supply electrical power to them, and to control their thermal conditions. Author

A92-29971#

RELIABILITY OF SOLID STATE POWER AMPLIFIER

H. HIROSE, T. ONO, N. MORITA, Y. KAZEKAMI, and T. IMATANI (Mitsubishi Electric Corp., Kamakura, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1901-1904. Research sponsored by INTELSAT.

(AIAA PAPER 92-1932) Copyright

Recent studies for the verification of the reliability of the solid state power amplifier (SSPA) and the design methodology for the high reliability SSPA are presented. The overall capability of communications payload including channel capacity, redundant configuration, and weight will be determined by the reliability of the power amplifier. Consideration is given to high power FET, a life-test of high power FET, thermal design, radiation effect on materials and parts, and the operational life-test of an SSPA.

R.E.P.

A92-30059

ELECTROMAGNETIC WAVE SCATTERING BY AN INFINITE PATCH ARRAY ON A DIELECTRIC SLAB

KAZUNORI UCHIDA, TAKEAKI NODA, and TOSHIAKI MATSUNAGA (Fukuoka Institute of Technology, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Dec. 1991, p. 4165-4171. refs

Copyright

This paper is concerned with a theoretical analysis of the electromagnetic wave scattering by an infinite rectangular patch array on a dielectric slab. The present analysis is based on the spectral domain method combined with the sampling theorem. The surface current distributions on the patch array are expanded

in nonharmonic Fourier series. Numerical examples are given for frequency and polarization characteristics as well as for the surface current distributions. Author

A92-31779

SS/FDMA ROUTER FOR FLEXIBLE SATELLITE COMMUNICATIONS NETWORKS

HIDEYUKI SHINONAGA and YASUHIITO ITO (Kokusai Denshin Denwa Co., Ltd., Research and Development Laboratories, Saitama, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. 10, Feb. 1992, p. 391-400. Research supported by INTELSAT. refs

Copyright

The subchannel switched frequency-division multiple-access (SS/FDMA) system improves the routing flexibility of transponder banks in channelized multibeam satellites. This system can efficiently be utilized to construct a VSAT (very small aperture terminal) network and/or a business satellite communications network using small aperture terminals. The authors address the application of the SS/FDMA system to such networks. A proof-of-concept (POC) model of an SS/FDMA onboard equipment called the SS/FDMA router is described in terms of its configuration and measured electrical performance. Results of transmission experiments using the POC model as well as computer simulations are presented. In addition, a redundant SS/FDMA router configuration is proposed, and its reliability is calculated for a 15-year satellite mission time. Finally, estimated values of volume, mass, and DC power consumption of the redundant SS/FDMA router are presented. I.E.

A92-31781

A GLOBAL MESSAGE NETWORK EMPLOYING LOW EARTH-ORBITING SATELLITES

JAIDEV KANIYIL, JUN TAKEI, SHIGERU SHIMAMOTO, YOSHIKUNI ONOZATO, TOMONORI USUI (University of Electro-Communications, Tokyo, Japan), IKUO OKA (Osaka City University, Japan), and TSUTOMU KAWABATA (University of Electro-Communications, Tokyo, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. 10, Feb. 1992, p. 418-427. refs

Copyright

A global message communication network for low-density traffic, using satellites at low altitudes, is described. This network affords around-the-clock service to any part of the globe, including the polar regions. Such a network can accommodate static and mobile user terminals simultaneously. The oblate globe is modeled as a regular polyhedron with 12 facets for setting up the orbits. Satellites are positioned uniformly in low-altitude symmetrical orbits. The symmetrical orbits are those whose axes are symmetrical in the three-dimensional space. The authors study the coverage aspects of the 6-orbit scheme and the 10-orbit scheme, each with satellites deployed at an altitude of 5000 km. At this altitude, the terrestrial user terminals can access satellites at a grazing angle of 45 deg. The method of access over the crosslinks is the slotted ALOHA scheme. For low-density traffic, the downlink and uplink throughput rates are estimated. Simulation results agree with these analytical estimates for low values of network offered load. I.E.

A92-31783

LINK-LEVEL CONNECTION CONTROL SCHEMES IN A HIGH-SPEED SATELLITE DATA NETWORK - A PERFORMANCE COMPARISON

SHUJI TASAKA (Nagoya Institute of Technology, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. 10, Feb. 1992, p. 437-446. refs

(Contract MOESC-02650244)

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The author makes a performance comparison between a connection-oriented (CO) logical link control (LLC) protocol and a connectionless (CL) LLC protocol in a high-speed satellite packet network with the time-division-multiple-access (TDMA)-reservation multiple-access protocol. In particular, how the channel transmission rate affects the performance of the two LLC protocols

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is examined. Which LLC protocol is more suitable for any given system environment is determined. The comparison indicates that the CL-LLC protocol has more advantages over the CO-LLC protocol as the channel transmission rate increased and that the suitable region for the CL-LLC protocol becomes wider as the receiver-buffer capacity increases and as the network load decreases. I.E.

A92-31784

A NEW SATELLITE COMMUNICATION SYSTEM INTEGRATED INTO PUBLIC SWITCHED NETWORKS - DYANET

MASAHUMI OHNUKI (NTT, Tokyo Technology and Development Center, Japan), MASAHIRO UMEHIRA, HIROSHI NAKASHIMA (NTT, Network Systems Development Center, Yokosuka, Japan), and SHUZO KATO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. 10, Feb. 1992, p. 447-455. refs

Copyright

A system concept of a common alternative routing system is proposed for reducing total network costs by integrating satellite communications into public-switched networks, where satellite systems carry overflow traffic from terrestrial systems through common satellite channels. This concept has been realized by a satellite communication system called DYANET (dynamic channel assigning and routing satellite aided digital networks), which provides trunk circuits in combination with terrestrial systems. The key technologies developed for DYANET are centralized network control system and a transponder hopping demand assignment TDMA (time-division multiple-access) system, to assure single-hop connection and to use satellite channels efficiently. The authors describe the system concept and configuration, the network control system, and the results of its commercial use. I.E.

A92-31785

A TDMA SATELLITE COMMUNICATION SYSTEM FOR ISDN SERVICES

SHUZO KATO, MASAHIRO MORIKURA, SHUJI KUBOTA, HIROSHI KAZAMA, KIYOSHI ENOMOTO (NTT, Radio Communications Systems Laboratories, Yokosuka, Japan), and MASAHIRO UMEHIRA (NTT, Network Systems Development Center, Yokosuka, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. 10, Feb. 1992, p. 456-464. refs

Copyright

The authors propose a TDMA (time-division multiple-access) satellite communication system suitable for both basic and primary ISDN services in addition to B-channel transmission lines among ISDN switches. To provide these service economically and efficiently, the proposed system uses an offset quadrature phase-shift keying (QPSK) burst modem coupled with high-coding gain and rate-forward-error correction, demand assignment technology for each data burst, and a transmission and reception transponder (carrier) hopping scheme. To realize cost-effective transmission and subscriber lines and to increase the reliability of TDMA terminals, major functions of TDMA terminals have been implemented in large-scale integrated circuits (LSICs), monolithic ICs (MICs), and hybrid ICs (HICs). The experimental results show narrow spectrum transmission with little bit error probability degradation for the offset QPSK burst modem and perfect operation of demand assignment and carrier hopping capability of the system. I.E.

A92-33628

WAVEGUIDE-FED PARALLEL PLATE SLOT ARRAY ANTENNA

JIRO HIROKAWA, MAKOTO ANDO, and NAOHISA GOTO (Tokyo Institute of Technology, Japan) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 40, Feb. 1992, p. 218-223. Research supported by Circle for Promotion of Science and Engineering in Japan. refs

(Contract MOESC-63420032)

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A novel planar antenna in which radiating slots are arrayed on

one side of a square parallel plate waveguide and coupling slots occupy the other side is proposed. The antenna is excited via the coupling slots by a rectangular waveguide. In order to suppress unwanted reflections and to assure the purity of the transverse electromagnetic (TEM) traveling-wave mode in the parallel plate waveguide, all the slots are arrayed in pairs. An X-band model antenna was fabricated, and uniform aperture illumination was demonstrated with 48 percent antenna efficiency. These results demonstrate the feasibility of antennas of this type. I.E.

A92-35056

SAR ANTENNA PATTERN AND MICROWAVE PENETRATION MEASUREMENT USING SPECTRUM ANALYZERS

HIROSHI KIMURA, MITSUNORI YOSHIMURA, and NOBUHIKO KODAIRA (Remote Sensing Technology Center of Japan, Tokyo) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 997-1000. Research supported by Japan Resources Observation System Organization. refs

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A convenient method to measure SAR (synthetic aperture radar) antenna patterns and microwave penetration of soil or trees using spectrum analyzers, which are popular instruments for high performance microwave measurements, and amateur use antennas is discussed. First, the received power by ground receiver is estimated for several SARs. This estimation suggests that spectrum analyzers can be used for ground measurement during SAR observation. In situ experimental measurements are presented. The application for the J-ERS-1 SAR is discussed. I.E.

A92-35062

DEVELOPMENT OF A FREQUENCY OFFSETTING ARC

MASAHARU FUJITA (Communications Research Laboratory, Koganei, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1023-1025. refs

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An ARC (active radar calibrator) is proposed for SAR (synthetic aperture radar) in which the frequency of a received SAR signal is shifted by a certain amount. The frequency shift causes a shift of the ARC image in an azimuth direction relative to its background. This function allows to enhance a signal-to-clutter ratio of the ARC image by moving it onto a dark background, and hence it would be of value for SAR calibration even at a narrow test site. The theory, design and development are described. I.E.

A92-35158

C- AND X-BAND POLARIMETRIC MICROWAVE SIGNATURES OF ARTIFICIAL RANDOM MEDIA

OSAMU KOBAYASHI, HARUTO HIROSAWA, and YUKIHIKO MATSUZAKA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1491-1494. refs

Copyright

To reveal the microwave signatures of random media, full-polarimetric backscatter measurements are made using a multipolarization power-measuring-type indoor scatterometer at C-band and X-band. Measured polarimetric characteristics of artificially fabricated random media (ensembles of dielectric rods/disks) are presented. The polarization signatures of ensembles of dielectric disks were analyzed qualitatively, considering the backscattering characteristics of a single scatterer and the structure of the media. The differences due to the elevation angle distribution were most clearly observed at X-band. For the ensemble of dielectric rods, the measured and the calculated polarimetric backscattering characteristics were compared. Fairly good agreement was observed between the two. I.E.

A92-35286

TEXTURE ANALYSIS USING A FRACTAL MATRIX MODEL

SHOICHI MASUDA (Earth Resources Satellite Data Analysis Center, Tokyo, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 2165-2168. refs

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Seasat Synthetic Aperture Radar (SAR) images taken from satellites are fractals. Until now, fractal features have been treated as scalar quantities, making it difficult to treat images containing considerable variation. An attempt is made to generalize the fractal dimension F obtained by multidimensionalizing the fractal relation. A fractal matrix (F-matrix) model is used for the texture analysis of mountains and other areas having considerable topographical variation in Seasat SAR images. The effectiveness of this method in remote sensing image classification is demonstrated. It is shown that the F-matrix model is effective in classifying the textures of different types of mountainous topography in Seasat SAR remote-sensing images of natural landscapes. This proves that the F-matrix contains significant information of value in texture analysis of remote-sensing images. I.E.

A92-35622

**EXPERIMENTS ON A SPACE DATA COMMUNICATION
PROTOCOL USING THE JAPANESE DOMESTIC
COMMUNICATIONS SATELLITE-3 (CS-3)**

HIDEO HARA, SHIGEO YAMADA, K. YAMAMOTO (NASDA, Tokyo, Japan), T. SATO, YOSHIKAZU FUJII, and K. TSUMURA (Fujitsu, Ltd., Atsugi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 39, 40. In Japanese.

A92-37456

SIMPLE ANTENNA FOR CIRCULAR POLARISATION

K. MAAMRIA (Tohoku University, Sendai, Japan) and T. NAKAMURA (Gifu University, Japan) IEE Proceedings, Part H - Microwaves, Antennas and Propagation (ISSN 0950-107X), vol. 139, no. 2, April 1992, p. 157, 158. refs

Copyright

The paper presents the design of a simple antenna for circular polarization. The antenna is a single-fed flat structure consisting of a pair of crossed dipoles connected through two angular branches, producing circular polarization in the axial direction. A design of the antenna with a director added to the structure to further narrow its beamwidth is analyzed. The design was realized, and its characteristics were measured at 2 GHz. It was found that measurements of the axial ratio, field pattern, and input admittance agreed well with computed values. I.S.

A92-40185

**STUDY STATUS OF PAN-PACIFIC INFORMATION NETWORK
USING A SATELLITE**

TAKASHI IIDA Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 171-179. Research supported by Okawa Institute of Information and Telecommunications and Research and Development Center for Radio Systems. refs

Copyright

The immediate goal of the Pan-Pacific Information Network, a nonprofit satellite communication system, is to construct a network using simple earth stations at low cost for mutual communication and information exchange in the fields of education, research, and health in the Pacific region. The study status of the network in Japan is described, as well as the concept of the Pan-Pacific Information Network and the activities related to the network in Japan. Ideas to help realize this network are outlined, and a demonstration of a TV conference using 64 kb/s satellite link was conducted through ETS-V between the University of Hawaii and the site of the Pan-Pacific Information Network Symposium held in Kobe, Japan, on November 1990. Other related activities

are presented, and various aspects of this network study are discussed. S.A.V.

A92-40186

**FILTERING IN THE ETS-V TRANSPONDER FOR MOBILE
COMMUNICATIONS EXPERIMENT**

KIMIO KONDO, RYUTARO SUZUKI, RYU MIURA, TOSHIYUKI IDE, MAKOTO SAKASAI, and NORIO FUTAGAWA (NEC Corp., Tokyo, Japan) Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 183-190. Research supported by Ministry of Transportation and NASDA. refs

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The Japanese ETS-V (Engineering Test Satellite V) realized an experimental mobile satellite communications system via a transponder called AMEX (Aeronautical Maritime Experimental Transponder). The L band is used for the mobile link and the C band for the feeder link. For the L-band two-beam system, routing and filtering are performed through 12 SAW filters and four switches in the IF part. Filtering to prevent EMC problems is also studied for AMEX. AMEX shows good performance in orbit and is being used for a variety of mobile communication experiments by many organizations, including Communications Research Laboratory.

Author

A92-40190

**EXPERIMENTS ON MARITIME SATELLITE COMMUNICATIONS
USING THE ETS-V SATELLITE**

HIROMITSU WAKANA, TETSUSHI IKEGAMI, FUMIO KAWAMATA, TOSHIYUKI IDE, and YASUSHI MATSUMOTO Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 223-237. refs

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Communications Research Laboratory has been carrying out on-board field experiments on a ship earth station based on digital modulation and coding technology by using the ETS-V. In order to obtain a better understanding of multipath fading under various sea condition and elevation angles, maritime satellite communication experiments have been conducted in the East China Sea, South China Sea, Indian Ocean and North and South Pacific Ocean. In this paper, good performances of fading reduction technique, antenna tracking system, data transmission and voice codec are described as well as signal degradation due to multipath fading at low elevation angles and blockage caused by ship superstructure. Author

A92-40191

**EXPERIMENTAL RESULTS OF TDM/TDMA SYSTEM VIA
ETS-V**

MAKOTO SAKASAI, EIHISA MORIKAWA, RYU MIURA, and YOSHIYA ARAKAKI Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 239-248. refs

Copyright

The Engineering Test Satellite-V (ETS-V) was launched in 1987, helping realize the Experimental Mobile Satellite System, where several types of mobile satellite communication experiments have been conducted. A simplified TDM/TDMA communication terminal equipment developed by the Communication Research Laboratory was used in ship experiments in the Pacific Ocean and South China Sea. This paper describes the data transmission, synchronization hold and initial acquisition characteristics resulting from these experiments. Author

A92-40193

**SPREAD SPECTRUM EQUIPMENT WITH COHERENT
MATCHED FILTER FOR MOBILE SATELLITE
COMMUNICATIONS**

TETSUSHI IKEGAMI, RYUTARO SUZUKI, NAOKAZU HAMAMOTO, and NOBUYASU SATO Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 269-281. refs

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The performance of a Direct Sequence Spread Spectrum

32 COMMUNICATIONS AND RADAR

Communication equipment with digital matched filter receiver for mobile satellite communications is evaluated with experiments. A Coherent Matched Filter (CMF) technique is used to accomplish fast code acquisition, automatic frequency control and coherent detection of data with a single matched filter circuit to satisfy the requirements for the mobile satellite applications. Loop-back test and field test results with the ETS-V satellite are presented. The use of multi-bit quantized correlators improve the initial acquisition and the bit error rate performances. The dynamic performance of the CMF receiver is confirmed to be satisfactory for the mobile satellite fading channels. Author

A92-40194

FADE/NON-FADE DURATION CHARACTERISTICS OF LAND MOBILE SATELLITE COMMUNICATION LINK

YOSHIHIRO HASE Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 283-293. Research supported by Science and Technology Agency of Japan and Aussat, Pty., Ltd. refs Copyright

Fade and nonfade duration characteristics of land mobile satellite links, which have not been well studied previously, were analyzed. Data used for the analysis were obtained in South Eastern Australia by receiving L-band CW signals from the Engineering Test Satellite. Results of the analysis show that the cumulative distributions of fade and nonfade durations follow log-normal and power law patterns, respectively. Many other interesting results were also obtained, for example, that the distribution does not depend on a threshold level defining fade and nonfade durations. Phase fluctuations of received signals were also analyzed. They were generally small, allowing the link characteristics to be estimated from levels only. Author

A92-40247

RECENT ACTIVITIES IN ANTENNAS AND PROPAGATION IN JAPAN

KENICHI KAGOSHIMA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) and TAKAYASU SHIOKAWA (Kokusai Denshin Denwa Co., Ltd., Kamifukuoka, Japan) IEEE Antennas and Propagation Magazine (ISSN 1045-9243), vol. 34, no. 2, April 1992, p. 18-26. refs Copyright

Recent Japanese activities in the fields of antennas and propagation are discussed. In the realm of antennas, developments in the areas of mobile communications antennas, multibeam earth station antennas, satellite-borne antennas for ETS-VI, and the shaped-beam antenna for the Superbird commercial domestic communications satellites are examined. In addition, antennas for the Japanese Earth Resources Satellite-1 SAR, the Japanese operational DBS, and for microwave radio-relay system are briefly discussed. In the field of propagation, developments in land-mobile radio systems, mobile satellite systems, fixed-satellite communication systems, and terrestrial radio systems are examined. S.A.V.

A92-40294

LOW-PROFILE HELICAL ARRAY ANTENNA FED FROM A RADIAL WAVEGUIDE

HISAMATSU NAKANO, HARUO TAKEDA, YORIIHIRO KITAMURA, HIROAKI MIMAKI, and JUNJI YAMAUCHI (Hosei University, Koganei, Japan) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 40, no. 3, March 1992, p. 279-284. refs Copyright

A low-profile array antenna composed of 2-turn 4 deg pitch angle helices is designed for a frequency band of 11.7 GHz to 12.0 GHz. The feed wire of each helix is inserted into a radial waveguide through a small hole and excited by a traveling wave flowing in the transverse electromagnetic mode between the two parallel plates of the waveguide. The measured aperture efficiency shows a maximum value of 77 percent for a beam radiated in the normal direction and 69 percent for a 30 deg beam tilt. Author

A92-41968

A VECTORIAL FINITE ELEMENT FORMULATION FOR ELECTROMAGNETIC WAVE PROPAGATION IN HELICAL SYSTEMS

H. IGARASHI and T. HONMA (Hokkaido University, Sapporo, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, no. 11, June 1, 1992, p. 5689-5693. refs Copyright

This paper describes a vectorial finite element method for the analysis of electromagnetic waves propagating in helical systems. The present method can be as easily used as the methods for guided electromagnetic waves in systems with translational and axial symmetries. The functional for the vector Helmholtz equation is minimized using twisted coordinates in which the problem becomes two-dimensional. The spurious solutions, which do not satisfy the divergence-free condition, are removed on the basis of the penalty method. Two finite element equations for the covariant and contravariant components of electromagnetic fields are derived and boundary conditions for both formulations are described. The present method is applied to the analysis of a twisted waveguide with a rectangular cross section and the numerical solutions are shown to be in good agreement with the perturbed solutions for a small helical pitch. Author

A92-42921

JAPAN'S TELECOMMUNICATIONS - NEW INITIATIVES IN SPACE COMMUNICATIONS

T. IIDA (Communications Research Laboratory, Tokyo, Japan) Space Communications (ISSN 0924-8625), vol. 9, no. 4, April 1992, p. 263-265. Copyright

Despite recent advances in optical transmission technology, intensive R&D work in the field of satellite communications is now being undertaken in Japan. It is believed that satellites offer advantages in several important areas, including wide coverage broadcasting, immediacy of service, suitability for the implementation of HDTV, and advantages in disaster communications and other social services. Here, some experimental projects in the field of satellite communications planned in Japan for the 1990s are summarized. In particular, attention is given to broadcast satellite development, intersatellite links, advanced mobile communication concepts, large antenna assembly experiment, small satellite R&D, and Pan-Pacific information network experiment. V.L.

A92-45971

A REFLECTION CANCELLING SLOT SET IN A LINEARLY POLARIZED RADIAL LINE SLOT ANTENNA

JUN-ICHI TAKADA, MAKOTO ANDO, and NAOHISA GOTO (Tokyo Institute of Technology, Japan) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 40, no. 4, April 1992, p. 433-438. refs

(Contract MOESC-63420032; MOESC-02952154)

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A radial line slot antenna (RLSA) is a high-gain and high-efficiency planar antenna. Circularly polarized RLSA (CP-RLSA) has realized the highest antenna efficiency of 85 percent to 60 cm phi DBS antenna. A linearly polarized RLSA (LP-RLSA) is also attractive for applications of various subscriber radio systems. However, the slot arrangement for linear polarization gives rise to serious reflection from slots, which disturbs the normal antenna operation. A new slot design of LP-RLSA is presented where reflection canceling slots are added to the conventional ones; four slots form one slot set as a unit radiator of linear polarization. The experiments confirm the design: the antenna return-loss is improved from -2 to -10 dB. The antenna efficiency of 48 and 54 percent are measured for 400 and 600 mm phi antennas, respectively. This is the first report of the normal operation of LP-RLSA's. Author

A92-47966

DEVELOPMENT OF A CYLINDRICAL NEAR-FIELD ANTENNA MEASUREMENT SYSTEM

KYOUICHI IIGUSA, YOSHIKI HORI, TAKEO ITOH, MASAHARU FUJITA, and TASUKU TESHIOGI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 37, no. 5, Dec. 1991, p. 517-541. In Japanese. refs

A cylindrical near-field antenna measurement (NFAM) system was developed by modifying a previously developed planar NFAM system. A computer program was written to convert near-field data into a far-field pattern based on the concept of the source scattering matrix formulation proposed by Yaghjian. This paper summarizes the theory of a cylindrical NFAM, and presents the configuration of the cylindrical NFAM system. The experimental results from using this system to measure a 1.6 GHz standard horn antenna are given. Finally, the advantages and disadvantages of a cylindrical NFAM and its characteristics are discussed and compared with those of a planar NFAM. The cylindrical NFAM system allows antenna patterns to be measured over a wide angle. Author

A92-48218
DEVELOPMENT OF A SMALL-SIZE LIGHT-WEIGHT SNG TRANSMISSION SYSTEM VIA SATELLITES USING THE DIGITAL BIT-REDUCTION TECHNOLOGY

SHIN-ETSU ITO and HIROSHI OKAMURA (Japan Broadcasting Corp., Broadcasting Center, Tokyo) IEEE Transactions on Broadcasting (ISSN 0018-9316), vol. 38, no. 2, June 1992, p. 98-105. refs

Copyright

The small, lightweight Satellite News Gathering (SNG) transmission system presented employs digital audiovisual bit-reduction technology to transmit news from remote gathering spots to the main receiving station in real time. The bit-reduction technology employed is the adaptive discrete-cosine transformation technique, which uses the block-matched vector system. The adaptive switcher unit finds that block of 8 x 8 pixels for which the sum of differences among pixels becomes minimum; this block is then used as the mode. O.C.

A92-48321
CHARACTERISTICS OF SMALL-APERTURE, SINGLE-LAYERED, RADIAL-LINE SLOT ANTENNAS

M. TAKAHASHI, J. TAKADA, M. ANDO, and N. GOTO (Tokyo Institute of Technology, Japan) IEE Proceedings, Part H - Microwaves, Antennas and Propagation (ISSN 0950-107X), vol. 139, no. 1, Feb. 1992, p. 79-83. refs

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A radial-line slot antenna (RLSA) is a high-efficiency planar array. A double-layered radial line and uniform slot length have been adopted in conventional RLSAs. A single-layered RLSA is much simpler in structure, but the slot length must be varied to synthesize uniform aperture illumination. Theoretical methods for the slot design are proposed. The paper presents excellent characteristics of single-layered RLSAs of small sizes (0.25-0.60 m diameter) and confirms the design. These are now commercialized for 12 GHz band DBS reception. Author

A92-51036
NOVEL SATELLITE DIGITAL VIDEO TDMA SYSTEM FOR BUSINESS VIDEO COMMUNICATIONS

SHUZO KATO, SHUJI KUBOTA, HIROSHI KAZAMA, and MASAHIRO MORIKURA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. 10, no. 6, Aug. 1992, p. 1054-1065. refs

Copyright

An integrated satellite digital video (ISDV) time division multiple access (TDMA) system is proposed for business video communications. The system is based on a multiple video signal transmission and reception capability and a backward voice signal transmission capability which use only one transponder. The employment of digital video transmission in conjunction with strong forward error correction makes it possible to realize a high-quality video signal transmission in interference environment. It is

concluded that the proposed ISDV system is capable of providing very cost-effective video communication systems by sharing the transponder capacity by multiple users and installing a number of small video-reception-only earth stations with both-way communication capability. O.G.

A92-52525
RAIN DEPOLARIZATION CHARACTERISTICS RELATED TO APPROXIMATE SPECIFIC ATTENUATION

Y. MAEKAWA, N. S. CHANG, and A. MIYAZAKI (Osaka Electro-Communication University, Neyagawa, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 16, July 30, 1992, p. 1557, 1558. refs

Copyright

Rainfall events obtained from the use of the CS-2 beacon signal are studied to relate rain-depolarization characteristics to rain attenuation per unit rainfall rate and unit path length. The component of differential attenuation obtained from the crosspolarized phase is examined in terms of possible depolarization cancellation. Mean crosspolarized phase is shown to be closely related to the approximate specific attenuation per unit rainfall rate. The mean crosspolar phase is distributed from -100 to -140 deg which can be attributed to the difference of drop-size distributions. Residual differential attenuation and the effectiveness of depolarization cancellation are concluded to be primarily determined by the size distribution of the raindrops. A detailed understanding of the drop-size distributions in local rain-depolarization events could contribute to more effective designs of satellite communication links. C.C.S.

A92-53680
MULTI-SLOTTED ALOHA SCHEME FOR VARIOUS LENGTH PACKET TRANSMISSION WITH HIGH EFFICIENCY

KATSUHIKO KAWAZOE, HIROSHI KAZAMA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan), and TATSURO MASAMURA (NTT, Network Systems Development Center, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1643-1648. refs

Copyright

Multi-slotted ALOHA (MS-ALOHA) is proposed as a highly efficient multiaccess scheme for satellite communication systems. The proposed scheme is based on Slotted-ALOHA (S-ALOHA) but employs multiple transmission timings and multiple slot sizes according to packet lengths to decrease collision probability. By analysis and computer simulation, it is shown that the maximum throughput of MS-ALOHA is higher than that of S-ALOHA by 20 percent for uniform packet length distribution. An application of this scheme to satellite TDMA systems is also proposed. Author

A92-53682
DEVELOPMENT OF LINK PERFORMANCE SIMULATION PROGRAM - LIPS

TOSHINARI KIMURA, HIDEO KOBAYASHI, and TOSHIO MIZUNO (Kokusai Denshin Denwa Co., Ltd., Meguro Research and Development Laboratories, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1655-1662. refs

Copyright

LIPS has been developed for the evaluation of digital satellite link performance in FDMA schemes. Attention is presently given to a theoretical description and simulation technique for the evaluation of such a scheme, as well as for the prediction of system capabilities. BER performance is compared with laboratory results in order to verify simulation results; good agreement is obtained between hardware and software simulations. O.C.

A92-53685
UNIQUE WORD DETECTION BASED ON THE RECOGNITION OF CORRELATION PATTERNS

HIDEYUKI SHINONAGA (Kokusai Denshin Denwa Co., Ltd.,

32 COMMUNICATIONS AND RADAR

Meguro Research and Development Laboratories, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1675-1684. refs
Copyright

The novel correlation-pattern detection method for unique-word (UW) detection presented is applicable to communications systems by employing a coherent-quadrature phase-shift keying modulation scheme; it also allows a flexible setting of the miss, false, and phase error detection probabilities. An optimum UW detection is by these means realized which minimizes total UW error probability, while still meeting specifications given for various probabilities. A tabulation of the correlation patterns and their number of possibilities is presented. O.C.

A92-53686

A STUDY ON THE 22 GHZ BAND SATELLITE BROADCASTING SYSTEM

TAKASHI UEHARA and YUTAKA KAWAGUCHI (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1685-1690. refs
Copyright

The Integrated Services Digital Broadcasting (ISDB) system, with a wide range of program-transmission possibilities, has been proposed for 22 GHz implementation. An account is presently given of a nationwide ISDB direct-broadcasting satellite system with 22-GHz downlink. Since the TWT required for rain-attenuation at 22 GHz may require more electrical power than is feasible in any practical satellite, a multibeam broadcasting satellite whose TWT usually operates at medium power is presently studied; this case will, however, compensate only 1 or 2 beams at a given time. O.C.

A92-53687

A STUDY ON SATELLITE BROADCASTING SERVICE IN THE 22 GHZ BAND

KOUZOU KAMEDA and TETSUO YAMAMOTO (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1691-1700. refs
Copyright

An investigation has been conducted of the fundamental features and capabilities of a 22 Hz satellite-broadcasting system employing digital modulation. Attention is given to the digital modulation parameters and the envisioned link budget, atmospheric factors affecting the use of the 22 GHz band, and such essential systems as those for error correction, modulation, channel allotment, antenna construction, and satellite power requirements. The required BER is $10 \exp -6$, and the link-budget margin, including demodulator degradation, is 2.5 dB. O.C.

A92-53689

THE DATA MULTIPLEXING SYSTEM WITH SATELLITE TELEVISION BROADCASTING IN JAPAN

TOSHIRO YOSHIMURA, MASATOSHI OHTA, and TADASHI ISOBE (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1707-1714. refs
Copyright

High data-transmission rate/large capacity broadcasting services are promised by the digital subcarrier of the NTSC sound/data system and the MUSE HDTV system. An account is presently given to the block codes for error correction, interleaving process, and majority-decision logic of these systems, which have been experimentally verified by means of transmission experiments with the BS-2b. It is established that these multiplexing systems yield sufficiently high transmission quality at even lower C/N values than those of tolerable video and audio signals. O.C.

A92-53692

AN APPLICATION OF SHAPED OFFSET-FED DUAL-REFLECTOR ANTENNA TO RECEIVING ANTENNA ON BROADCASTING SATELLITES

KAZUYOSHI SHOGEN and NOBORU TOYAMA (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1725-1731. refs
Copyright

Numerical results are presented for the shape of the offset-fed dual reflectors and the radiation patterns of a high-gain beam-scanning antenna that can be used as the receiver in direct-broadcast satellites. The radiation pattern thus obtained is compared with that of a conventional dual-reflector antenna, to demonstrate the effects of reflector shaping; the beam width of the proposed antenna is narrower than that of the conventional design. O.C.

A92-53701

PACKET MESSAGE COMMUNICATION SYSTEM USING POLAR ORBITING SMALL SATELLITES

RYUTARO SUZUKI, YOSHIKI SUZUKI, YOSHINORI ARIMOTO (Communications Research Laboratory, Koganei, Japan), SHINGO OHMORI (Kashima Space Research Center, Japan), and KIMIO KONDO (Communications Research Laboratory, Koganei, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1785-1790.
Copyright

A packet message communication system using small satellites is studied for the worldwide electronic mail type communications. A store and forward type packet communication equipment is installed in a small satellite which rotates in the polar orbit. By using the inter satellite link among the small satellites and/or the data exchange earth station in the polar region, the delay time of the packet message delivery can be shortened. The multibeam phased array technique is applied for the satellite antenna in order to increase the link quality. Four satellites configuration gives a 4.8 kbps data rate message with less than two hours of delay. Author

A92-53702

LAND MOBILE COMMUNICATION EXPERIMENTS USING ETS-V

KIMIO KONDO, RYUTARO SUZUKI, YUKIO HASHIMOTO, NAOKAZU HAMAMOTO, YASUSHI MATSUMOTO (Communications Research Laboratory, Koganei, Japan), SHINICHI TAIRA, and SHINGO OHMORI (Kashima Space Research Center, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1791-1796. refs
Copyright

Japan's Communications Research Laboratory is employing the Engineering Test Satellite (ETS) V to conduct land mobile communications experiments with hand-held communicators for users of trains and automobiles. These encompass propagation experiments for the study of multipath fading and blocking effects; train-riding communicator users noted the emergence of spark noise. Both digital and analog voice and data were successfully transmitted via three different types of modem. Low bit-rate message communication experiments were also conducted. O.C.

A92-53704

A POSSIBLE EVOLUTION OF 20/30 GHZ DOMESTIC SATELLITE COMMUNICATION SYSTEMS TOWARDS VERY HIGH CAPACITY

GIORGIO PERROTTA (Selenia Spazio S.p.A., Rome, Italy) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1803-1808. refs
Copyright

An evaluation is presented of prospective ultrawideband,

trunk-type satellite system applications, in light of a specific conceptual design and a plausible course for its implementation. Attention is given to technology-readiness issues in the near term for a four-satellite cluster system, each of whose spacecraft carry 48 transponders and two 4-m diameter antennas furnishing 12 spot-beams each. This will allow about 280,000 telephone circuits to be exchanged among 50 trunk-type teleports. Yearly transponder and circuit cost estimates are provided. O.C.

A92-53726

EVALUATION OF SURFACE CLUTTER FOR THE DESIGN OF SPACEBORNE RAIN RADAR

HIROSHI HANADO and TOSHIO IHARA (Kashima Space Research Center, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1953-1958. refs Copyright

Effects of surface clutter interference through antenna sidelobe on rainfall measurements, which is one of the most important technological issues to realize spaceborne rain radar, are quantitatively examined in order to clarify the antenna design criteria. The received intensities of both rain echo and sea clutter are evaluated by numerically integrating both radar equations, assuming appropriate precipitation and sea surface scattering property models and realistic antenna pattern of phased array antenna, which is fed with the Taylor distribution of sidelobe level -30 dB with exciting currents errors being superimposed. The results illustrate that there exists a severely interfered region directly adjacent to the sea surface due to antenna mainlobe-sea clutter coupling. They also demonstrate the feasibility of quantitative measurements of rainfall, except the above region, with the planar array antenna fed according to the Taylor distribution of sidelobe level -30 dB. Author

A92-53727

BIASES OF ESTIMATED RAINFALL RATE CAUSED BY NON-UNIFORMITY OF RAIN IN RAIN RETRIEVAL ALGORITHMS FOR SPACEBORNE RAIN RADAR

KENJI NAKAMURA (Communications Research Laboratory, Koganei, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1959-1964. refs Copyright

The biases of various rain retrieval algorithms proposed for spaceborne rain radar due to nonuniformity of rain are discussed. The biases are studied using simple models and an actual time sequence of rainfall rate. Conventional rain retrieval algorithm always overestimates, but the bias is moderate. The surface reference-method which is one of the algorithms using rain attenuation always underestimates. The bias is large and has a possibility of being only half as large as the actual mean rainfall rate. The dual-frequency-method, which is another algorithm using rain attenuation, shows large variations which depends on the rain depth and the range between two range gates which are used to estimate the rain attenuation. A result of the biases using actual rainfall rates suggests that there exists an optimum averaging period where the bias is nearly constant. Author

A92-55800

STUDY OF MICROSAT COMMUNICATION SYSTEM

K. KONDO, Y. HASHIMOTO, R. SUZUKI, M. TANAKA, T. IKEGAMI (Communications Research Laboratory, Koganei, Japan), T. OBUCHI, O. NAKAGAWA, and M. MATSUI (NEC Corp., Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992, 7 p. refs (IAF PAPER 92-0431) Copyright

Possible applications of microsatellites are briefly reviewed, and a simple microsatellite communication network is proposed. The general design of the proposed microsatellite communication system is discussed, with attention given to the radio link for ground stations, intersatellite radio link, conceptual design of the

satellite bus system, microsatellite antenna design, and design of the store and forward transponder. V.L.

A92-55939

LAND MOBILE SATELLITE PROPAGATION EXPERIMENTS IN KYOTO CITY

Y. MATSUMOTO, R. SUZUKI, K. KONDO (Communications Research Laboratory, Koganei, Japan), and M. H. KHAN (Lakehead University, Thunder Bay, Canada) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 28, no. 3, July 1992, p. 718-728. Research supported by Japan International Science and Technology Exchange Center and NSERC. refs Copyright

N92-11225*# Loyola Coll., Baltimore, MD. Japanese Technology Evaluation Center.

HIGH DEFINITION SYSTEMS IN JAPAN

RICHARD J. ELKUS, JR., ROBERT B. COHEN, BIRNEY D. DAYTON, DAVID G. MESSERSCHMITT, WILLIAM F. SCHREIBER, LAWRENCE E. TANNAS, JR., and DUANE SHELTON Feb. 1991 224 p Sponsored in part by NASA, NSF, DARPA, DOC, and DOE (Contract NSF ECS-89-02528) (NASA-TM-105108; NAS 1.15:105108; PB91-100032) Avail: CASI HC A10/MF A03

The successful implementation of a strategy to produce high-definition systems within the Japanese economy will favorably affect the fundamental competitiveness of Japan relative to the rest of the world. The development of an infrastructure necessary to support high-definition products and systems in that country involves major commitments of engineering resources, plants and equipment, educational programs and funding. The results of these efforts appear to affect virtually every aspect of the Japanese industrial complex. The results of assessments of the current progress of Japan toward the development of high-definition products and systems are presented. The assessments are based on the findings of a panel of U.S. experts made up of individuals from U.S. academia and industry, and derived from a study of the Japanese literature combined with visits to the primary relevant industrial laboratories and development agencies in Japan. Specific coverage includes an evaluation of progress in R&D for high-definition television (HDTV) displays that are evolving in Japan; high-definition standards and equipment development; Japanese intentions for the use of HDTV; economic evaluation of Japan's public policy initiatives in support of high-definition systems; management analysis of Japan's strategy of leverage with respect to high-definition products and systems. Author

N92-15213# Nippon Telegraph and Telephone Public Corp., Yokosuka (Japan).

SATELLITE AND TERRESTRIAL INTEGRATED SERVICES DIGITAL NETWORKS IN JAPAN

HEIICHI YAMAMOTO and SHUZO KATO In ESA, Second European Conference on Satellite Communications (ECSC-1) p 9-14 Oct. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

Satellite and terrestrial Integrated Services Digital Networks (ISDN) to provide cost effective ISDN services and to enhance installation of ISDN services all over the nation are proposed. The proposed networks are based on the traffic sharing between satellite and terrestrial networks for traffic transmission among telephone offices and provide satellite subscriber lines for ISDN customers in rural areas. The former DYANET (dynamic channel assigning routing satellite aided digital networks) (1) takes the advantage of high transmission efficiency of terrestrial networks for steady traffic and the advantage of high transmission efficiency of satellite communications for light and dynamically varying traffic. By employing demand assignment and transponder hopping (for both transmission and reception) techniques, effective satellite transmission capacity is increased to five to six times higher than that of preassignment systems. Moreover, earth station cost was

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significantly reduced by Large Scale Integrated Circuits (LSIC) and Monolithic Integrated Circuit (MIC) implementation and by the development of dual beam antennas. DYANET 1 has been in perfect operation employing 64 Time Division Multiple Access (TDMA) earth stations since 1988 and the latter (DYANET 2) will be put into commercial use from mid 1991. ESA

N92-15215# National Space Development Agency, Tokyo (Japan). Communications and Broadcasting Satellite Group.

THE OUTLINE OF THE COMMUNICATIONS AND

BROADCASTING ENGINEERING TEST SATELLITE (COMETS)

HISASHI MORIKAWA, TOSHIKAZU KOTO, AKIRA AWASAWA, CHIHARU OHUCHI, and YUICHI FUJIWARA. In ESA, Second European Conference on Satellite Communications (ECSC-2) p 23-28 Oct. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The National Space Development Agency of Japan (NASDA) plans to launch the Communications and Broadcasting Engineering Test Satellite (COMETS) by the H 2 rocket at the beginning of 1997. The research and development for Communications Satellite 4 (CS 4) and Experimental Data Relay and Tracking Satellite (EDRTS) were changed into the new project of COMETS in June 1990. COMETS is being developed to experimentally demonstrate new technology in the areas of inter orbit communication, the advanced satellite broadcasting on Ka band and the advanced mobile satellite communication on Ka band and millimeter wave band. The program outline of COMETS and the outline of three missions and onboard equipment are presented. ESA

N92-15283# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

EXPERIMENTAL ADVANCED MOBILE SATELLITE COMMUNICATIONS SYSTEM IN MM-WAVE AND KA-BAND USING JAPAN'S COMETS

S. ISOBE (Ministry of Posts and Telecommunications, Tokyo (Japan).), N. HAMAMOTO (Telecommunications Satellite Corp. of Japan, Kimitsu.), M. TAKEUCHI (Ministry of Posts and Telecommunications, Tokyo (Japan).), S. OHMORI (Ministry of Posts and Telecommunications, Tokyo (Japan).), and M. YAMAMOTO (Telecommunications Satellite Corp. of Japan, Kimitsu.) In ESA, Second European Conference on Satellite Communications (ECSC-2) p 487-490 Oct. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The Communications Research Laboratory (CRL) has been studying an advanced mobile satellite communications system using millimeter wave and Ka band in the Communications and Broadcasting Engineering Test Satellite (COMETS) project. The project started in 1990 and the satellite will be launched in 1997. Onboard multibeam interconnecting is one of the basic functions to realize onehop connection among mobile and hand held terminals and Very Small Aperture Terminals (VSAT's) in future mobile satellite communications systems. An intermediate frequency (IF) filter bank and regenerative transponder are suitable for this function. The transponder configuration of an advanced mobile communications mission of the COMETS for experiment is shown. High power transmitters of millimeter wave and Ka bands, a 3 by 3 IF filter bank, and Single Channel Per Carrier/Time Division Multiplexing (SCPC/TDM) regenerative modems are the purpose of studying the feasibility of advanced mobile communications systems. ESA

N92-22822# Niigata Univ. (Japan). Faculty of Electronics.

ADAPTIVE COMMUNICATIONS POLARIMETRY: SENSING OF PROPAGATION PATH CHANGES AND ADAPTATION TO OPTIMAL PERFORMANCE IN CELLULAR COMMUNICATIONS

YOSHIO YAMAGUCHI (Niigata Univ. (Japan).), HYO JOON EOM (Korea Inst. of Tech., Tae-Jon (Republic of Korea).), and WOLFGANG-MARTIN BOERNER (Illinois Univ., Chicago.) In AGARD, Remote Sensing of the Propagation Environment 6 p Feb. 1992

Copyright Avail: CASI HC A02/MF A03

Basic principles of radar polarimetry are applied to radio communications under the conditions that the polarization state of the incoming wave changes according to effects caused by the propagation environment. Since the polarization state of an incoming wave cannot be controlled, the only possible way to control the receiving power is the polarization state of the receiving antenna. Based on basic principles of radar polarimetry, the matching and mismatching conditions are derived using the Poincare sphere. An interesting relation was found between the maximal and minimal polarization states with respect to that of the incoming wave, i.e., these points constitute a great circle on the Poincare sphere and that they form a right angle triangle on the great circle. Therefore, if the polarization of the incoming wave is given, these maximal and minimal polarization points can be determined graphically on the Poincare sphere instantaneously. This concept of adaptive communications polarimetry may be useful not only to cellular radio communication systems, but to fixed station link radio communication systems suffering from atmospheric fluctuations as well. Author

N92-22969# National Lab. for High Energy Physics, Tsukuba (Japan).

USER'S GUIDE TO DENKAI

TSUMORU SHINTAKE Jun. 1991 26 p

(DE92-751022; KEK-91-3) Avail: CASI HC A03/MF A01

DENKAI is a set of computer programs to calculate the 2-dimensional electrostatic field with cylindrical symmetry. Using simple commands, triangle meshes are automatically generated in the MESH GENERATOR routine. The bandwidth of the coefficient matrix is reduced in the BAND WIDTH routine. The Laplace equation of the electrostatic field is solved in the FIELD routine by inverting the coefficient matrix using Gauss method. The electric field lines are plotted by the FIELD PLOT routine, and the electric field intensities on arbitrary boundary can be read out by the FIELD LIST routine. DOE

N92-24086*# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

MULTI-CARRIER MOBILE TDMA SYSTEM WITH ACTIVE ARRAY ANTENNA

RYUTARO SUZUKI, YASUSHI MATSUMOTO, and NAOKAZU HAMAMOTO In JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 90-94 1990

A multi-carrier time division multiple access (TDMA) is proposed for the future mobile satellite communications systems that include a multi-satellite system. This TDMA system employs the active array antenna in which the digital beam forming technique is adopted to control the antenna beam direction. The antenna beam forming is carried out at the base band frequency by using the digital signal processing technique. The time division duplex technique is applied for the TDM/TDMA burst format, in order not to overlap transmit and receive timing. Author

N92-24088*# Ministry of Posts and Telecommunications, Kashima (Japan). Communications Research Lab.

HYBRID SYSTEM OF COMMUNICATION AND RADIO DETERMINATION USING TWO GEOSTATIONARY SATELLITES

SHINGO OHMORI (Ministry of Posts and Telecommunications, Ibaraki (Japan).), YASUSHI MATSUMOTO (Ministry of Posts and Telecommunications, Ibaraki (Japan).), EIHISA MORIKAWA (Ministry of Posts and Telecommunications, Ibaraki (Japan).), and MASAYOSHI WAKAO (Research and Development Center for Radio Systems, Tokyo, Japan) In JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 103-108 1990

A new hybrid satellite system which can provide both communications and positioning services in one system using two geostationary satellites is discussed. The distinctive feature is that location information can be provided by transmitting and receiving ranging signals over the same channel as communications through two geostationary satellites. Author

N92-24104*# Nippon Telegraph and Telephone Public Corp., Yokosuka (Japan). Communication Systems Lab.

SOFT-DECISION VITERBI DECODING WITH DIVERSITY COMBINING

T. SAKAI, K. KOBAYASHI, and S. KATO /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 200-204 1990

Diversity combining methods for convolutional coded and soft-decision Viterbi decoded channels in mobile satellite communications systems are evaluated and it is clarified that the pre-Viterbi-decoding maximal ratio combining shows better performance than other methods in Rician fading channels by computer simulation. A novel practical technique for maximal ratio combining is proposed, in which the coefficients for weighting are derived from soft-decision demodulated signals only. The proposed diversity combining method with soft-decision Viterbi decoding requires simple hardware and shows satisfactory performance with slight degradation of 0.3 dB in Rician fading channels compared with an ideal weighting scheme. Furthermore, this diversity method is applied to trellis coded modulation and significant P_e performance improvement is achieved. Author

N92-24111*# Ministry of Posts and Telecommunications, Kashima (Japan). Communications Research Lab.

SPREAD SPECTRUM MOBILE COMMUNICATION EXPERIMENT USING ETS-V SATELLITE

TETSUSHI Ikegami (Ministry of Posts and Telecommunications, Kashima (Japan).), RYUTARO SUZUKI (Ministry of Posts and Telecommunications, Tokyo (Japan).), NAOTO KADOWAKI (Ministry of Posts and Telecommunications, Kashima (Japan).), SHINICHI TAIRA (Ministry of Posts and Telecommunications, Kashima (Japan).), and NOBUYASU SATO (Toshiba Corp., Kawasaki, Japan) /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 246-252 1990

The spread spectrum technique is attractive for application to mobile satellite communications, because of its random access capability, immunity to inter-system interference, and robustness to overloading. A novel direct sequence spread spectrum communication equipment is developed for land mobile satellite applications. The equipment is developed based on a matched filter technique to improve the initial acquisition performance. The data rate is 2.4 kilobits per sec. and the PN clock rate is 2.4552 mega-Hz. This equipment also has a function of measuring the multipath delay profile of land mobile satellite channel, making use of a correlation property of a PN code. This paper gives an outline of the equipment and the field test results with ETS-V satellite. Author

N92-24114*# Fujitsu Ltd., Kawasaki (Japan). Radio and Satellite Communication Systems Lab.

A SPREAD-SPECTRUM MODEM USING CONSTANT ENVELOPE BPSK FOR A MOBILE SATELLITE COMMUNICATIONS TERMINAL

N. IIZUKA (Fujitsu Ltd., Kawasaki (Japan).), A. YAMASHITA (Fujitsu Ltd., Kawasaki (Japan).), S. TAKENAKA (Fujitsu Ltd., Kawasaki (Japan).), E. MORIKAWA (Ministry of Posts and Telecommunications, Ibaraki (Japan).), and T. IKEGAMI (Ministry of Posts and Telecommunications, Kashima, Japan) /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 267-271 1990

This paper describes a 5-kilobit/s spread spectrum modem with a 1.275 mega-Hz chip rate for mobile satellite communications. We used a Viterbi decoder with a coding gain of 7.8 dB at a BER of 10^{-5} to decrease the required receiver power. This reduces the cost of communication services. The spread spectrum technique makes the modem immune to terrestrial radio signals and keeps it from causing interference in terrestrial radio systems. A class C power amplifier reduces the modem's power consumption. To avoid nonlinear distortion caused by the amplifier, the envelope of the input signal is kept constant by adding quadrature channel signal to the BPSK signal. To simulate the worst case, we measured the modem's output spectrum using a

limiting amplifier instead of the class C amplifier, and found that 99 percent of the spectral power was confined to the specified 2.55 mega-Hz bandwidth. Author

N92-24138*# Nippon Electric Co. Ltd., Yokohama (Japan).

A GENERALIZED TRANSMULTIPLEXER AND ITS APPLICATION TO MOBILE SATELLITE COMMUNICATIONS

OSAMU ICHIYOSHI /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 417-422 1990

A generalization of digital transmultiplexer technology is presented. The proposed method can realize transmultiplexer (TMUX) and transdemultiplexer (TDUX) filter banks whose element filters have bandwidths greater than the channel spacing frequency. This feature is useful in many communications applications. As an example, a satellite switched (SS) Frequency Division Multiple Access (FDMA) system is proposed for spot beam satellite communications, particularly for mobile satellite communications. Author

N92-24154*# Nippon Electric Co. Ltd., Kawasaki (Japan). C and C System Research Labs.

PERFORMANCE EVALUATION OF A MOBILE SATELLITE SYSTEM MODEM USING AN ALE METHOD

TOMOKI OHSAWA (Nippon Electric Co. Ltd., Kawasaki (Japan).) and MOTOYA IWASAKI (Nippon Electric Co. Ltd., Yokohama, Japan) /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 511-515 1990

Experimental performance of a newly designed demodulation concept is presented. This concept applies an Adaptive Line Enhancer (ALE) to a carrier recovery circuit, which makes pull-in time significantly shorter in noisy and large carrier offset conditions. This new demodulation concept was actually developed as an INMARSAT standard-C modem, and was evaluated. On a performance evaluation, 50 symbol pull-in time is confirmed under 4 dB Eb/No condition. Author

N92-24155*# Ministry of Posts and Telecommunications, Kashima (Japan). Communications Research Lab.

A PHASED ARRAY TRACKING ANTENNA FOR VEHICLES

SHINGO OHMORI (Ministry of Posts and Telecommunications, Kashima (Japan).), KAZUKIKO MANO (Ministry of Posts and Telecommunications, Kashima (Japan).), KENJI TANAKA (Ministry of Posts and Telecommunications, Kashima (Japan).), MAKOTO MATSUNAGA (Mitsubishi Electric Corp., Hyogo (Japan).), and MAKIO TSUCHIYA (Mitsubishi Electric Corp., Amagasaki, Japan) /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 519-522 1990

An antenna system including antenna elements and a satellite tracking method is considered a key technology in implementing land mobile satellite communications. In the early stage of land mobile satellite communications, a mechanical tracking antenna system is considered the best candidate for vehicles, however, a phased array antenna will replace it in the near future, because it has many attractive advantages such as a low and compact profile, high speed tracking, and potential low cost. Communications Research Laboratory is now developing a new phased array antenna system for land vehicles based on research experiences of the airborne phased array antenna, which was developed and evaluated in satellite communication experiments using the ETS-V satellite. The basic characteristics of the phased array antenna for land vehicles are described. Author

N92-24173*# Nippon Electric Co. Ltd., Kawasaki (Japan). C and C Systems Research Labs.

A NEW COHERENT DEMODULATION TECHNIQUE FOR LAND-MOBILE SATELLITE COMMUNICATIONS

SHOUSEI YOSHIDA and HIDEHO TOMITA /*n* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 622-627 1990

An advanced coherent demodulation technique is described for land mobile satellite (LMS) communications. The proposed

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technique features a combined narrow/wind band dual open loop carrier phase estimator, which is effectively able to compensate the fast carrier phase fluctuation by fading with sacrificing a phase slip rate. Also included is the realization of quick carrier and clock reacquisition after shadowing by taking open loop structure. Its bit error rate (BER) performance is superior to that of existing detection schemes, showing a BER of 1×10^{-2} at 6.3 dB E sub b/N sub o over the Rician channel with 10 dB C/M and 200 Hz (1/16 modulation rate) fading pitch f sub d for QPSK. The proposed scheme consists of a fast response carrier recovery and a quick bit timing recovery with an interpolation. An experimental terminal model was developed to evaluate its performance at fading conditions. The results are quite satisfactory, giving prospects for future LMS applications. Author

N92-24249# RAND Corp., Santa Monica, CA.
TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY STANDARD-SETTING IN JAPAN: A PRELIMINARY SURVEY
STANLEY M. BESEN 1991 27 p Sponsored in part by Boeing Commercial Airplane Group, Citicorp; The Ford Foundation; Hitachi; IBM-Japan; C. Itoh; Kawasaki Heavy Industries; Kobe Steel; John and Mary Markle Foundation; Minebea; Motorola; Nomura Research Inst.; Toshiba, UA; Xerox
(RAND-N-3204-CUSJR; AD-B165695L) Avail: CASI HC A03/MF A01

This note describes and analyzes telecommunications and information technology standard setting in Japan, compares the organization and structure of a private Japanese voluntary standard organization with those of similar European and American organizations, and examines the prospects for cooperating among these groups. Author

N92-25622# Japan Resources Observation System Organization.

SAR DEVELOPMENT STATUS

YUKIAKI NEMOTO In NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 7-18 2 Nov. 1990
(EW-2) Avail: CASI HC A03/MF A02

Presented in viewgraph format, the status of SAR (Synthetic Aperture Radar) development on the JERS-1 (Japan Earth Resources Satellite-1) are described. Topics addressed include: block diagram of SAR; functional block diagram of signal processor; specification of SAR; SAR data sequence; radar calibration; SAR raw data format at observation mode and calibration mode; and schedules of SAR development. Author (NASDA)

N92-30924*# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

ADVANCED MOBILE SATELLITE COMMUNICATIONS SYSTEM USING KA AND MM-WAVE BANDS IN JAPAN'S R AND D SATELLITE PROJECT

SHUNKICHI ISOBE, SHINGO OHMORI, NAKAZU HAMAMOTO, and MINORU YAMAMOTO In JPL, Proceedings of the Workshop on Advanced Network and Technology Concepts for Mobile, Micro, and Personal Communications p 15-19 15 Sep. 1991
Avail: CASI HC A01/MF A03

Communications Research Laboratory (CRL) studied an advanced mobile satellite communications system using Ka and millimeter-wave bands in the R&D Satellite project. The project started in 1990 and the satellite will be launched in 1997. On-board multi-beam interconnecting is one of basic functions to realize one-hop connection among Very Small Aperture Terminals (VSATs), mobile, and hand-held terminals in future mobile satellite communications system. An Intermediate Frequency (IF) filter bank and regenerative transponder are suitable for this function. The transponder configuration of an advanced mobile communications mission of the R&D Satellite for experiment is shown. High power transmitters of Ka and millimeter-wave bands, a 3x3 IF filter band and Single Channel Per Carrier/Time Division Multiplexing (SCPC/TDM) regenerative MODEMS, which will be boarded on the R&D Satellite, are being developed for the purpose of studying

the feasibility of advanced mobile communications system.

Author

N92-30927*# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

EXPERIMENTAL MILLIMETER-WAVE PERSONAL SATELLITE COMMUNICATIONS SYSTEM

YOSHIAKI SUZUKI, SHIGERU KIMURA, MASAOKI SHIMADA, MASATO TANAKA, and YASUHIRO TAKAHASHI In JPL, Proceedings of the Workshop on Advanced Network and Technology Concepts for Mobile, Micro, and Personal Communications p 55-64 15 Sep. 1991
Avail: CASI HC A02/MF A03

Communications Research Laboratory (CRL) has investigated an advanced millimeter (mm)-wave satellite communications system for personal use. Experiments in mm-wave personal satellite communication are to be conducted for 3 years using Japan's Engineering Test Satellite VI (ETS-VI). This paper describes an experimental mm-wave (43/38 GHz) personal satellite communication system, including an onboard transponder and an earth terminal. The on-board transponder is almost completed, and the ground experiment system is still in the design stage. The transponder employs advanced mm-wave solid state technology. It uses 38 GHz high power solid state amplifiers to accelerate the development of mm-wave solid state devices which are indispensable to personal earth terminals. The transponder consists of a 43 GHz receiver with a built-in low noise amplifier, an IF filter section with very narrow bandwidth to improve the carrier-to-noise power ratio of the weak personal communication signal, and two high power amplifiers using newly developed high power Gallium Arsenide (GaAs) metal-semiconductor field effect transistors (MESFETs). Author

N92-70965 National Inst. of Polar Research, Tokyo (Japan). **JARE DATA REPORTS. NO. 146 (IONOSPHERE 40). RECORDS OF RADIO AURORA AT SYOWA STATION, ANTARCTICA, 1987**

HIDEO MAENO (Ministry of Posts and Telecommunications, Tokyo, Japan) and KOJI INAMORI (Ministry of Posts and Telecommunications, Tokyo, Japan) Mar. 1989 36 p (ISSN 0075-3343)
Avail: CASI HC A03

Observation of ionospheric irregularities were carried out at Syowa Station, Antarctica, by means of an auroral radar since March 1966. A report was prepared which includes the periods of 112 MHz radio auroral echoes detected in 1987. Two kinds of data are available; (1) 35 mm film records of radio auroral echo intensity with range (A-scope) and range-time intensity (A'-scope); and (2) chart records of the time variation of echo intensity. Author

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ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

A92-10301

ELECTRICAL CHARACTERISTICS OF HOBA2CU3O(7-X) - LA(1.5)BA(1.5)CU3O(7-Y) - HOBA2CU3O(7-X) JUNCTIONS WITH PLANAR-TYPE STRUCTURES

UKI KABASAWA, YOSHINOBU TARUTANI, TOKUUMI FUKAZAWA, AKIRA TSUKAMOTO, MASAHIKO HIRATANI, and KAZUMASA TAKAGI (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Aug. 1991, p. 1670-1675. Research sponsored by New Energy and Industrial Technology Development

Organization of Japan. refs
Copyright

The fabrication of superconducting junction is described, and an investigation is conducted into the structural and superconducting characteristics. The $\text{HoBa}_2\text{Cu}_3\text{O}_{(7-x)}$ layer is sectioned into two electrodes which are placed less than one micron apart on the La-based layer. The junction is found to generate a measurable supercurrent when the electrodes are separated by less than 0.4 microns, and the critical current varies exponentially with electrode spacing. The critical current of the junction is linearly dependent on temperature as opposed to the normal resistance value which reflects the resistivity of the La-based layer. The La-based layer has an unexpectedly long superconducting decay length and unusual superconducting characteristics which cannot be defined in terms of proximity theory. C.C.S.

A92-10303
PROPERTIES OF SUPERCONDUCTIVE STRIP-LINE
RESONATORS FABRICATED USING EUBACUO FILMS ON
MgO (100)

YASUHIRO NAGAI, MAKOTO SATO, HIDEFUMI ASANO, SHUGO KUBO, and TUNEO KONAKA (NTT, Tokai, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Aug. 1991, p. 1679-1684. refs
Copyright

The paper reports on the properties of superconductive strip-line resonators fabricated using EuBaCuO superconducting films on MgO (100) substrates. A high loaded-Q of 22,000 and an unloaded-Q of 24,000 are realized at 35.5 K and 5.55 GHz. The surface resistance is calculated as 160 microohms without any correction and 50 microohms with correction. In addition, a resonant frequency shift of 40 MHz occurs in the measurement range. This shift can be explained by the reduction in penetration depth due to the decrease in temperature. From this shift, penetration depth at 0 K is estimated to be 0.75 microns. Furthermore, there is no change in the unloaded-Q in the power region below -10 dBm, but then the unloaded-Q gradually decreases as the input power is increased although the penetration depth hardly varies. This limitation does not indicate that the whole superconductive phase is weakened. The influence of air spacing on resonant frequency is also discussed for MgO and LaAlO_3 substrates. Author

A92-10304
ELECTROLUMINESCENT DEVICE MADE OF DIAMOND
NAOJI FUJIMORI, YOSHIKI NISHIBAYASHI, and HIROMU SHIOMI (Sumitomo Electric Industries, Ltd., Itami Research Laboratories, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Aug. 1991, p. 1728-1730. refs
Copyright

A Schottky contact and boron-doped epitaxial diamond film are employed to fabricate an electroluminescent device, and the properties of the electroluminescence are described. Diamond deposition is conducted with microwave-plasma chemical-vapor deposition, and diamond crystals synthesized under high pressure are used for the substrates. The device is delineated with attention given to the Schottky behavior of the tungsten electrode. Studies of cathodoluminescence and optical absorption are used to identify several color centers. The emission spectrum is similar to that of cathodoluminescence with the spectral center at 530 nm, and the emitting center is identified as the color center designated 'band A'. The injection electroluminescence is concluded to be the cause of the emission in the diamond-based diode. C.C.S.

A92-10306
HYPERVELOCITY ACCELERATORS WITH
ELECTRO-THERMO-CHEMICAL REACTION
KAZUNARI IKUTA (Japan Steel Works, Ltd., Chiba, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Aug. 1991, p. 1863-1867. refs
Copyright

A novel kind of electro-thermo-chemical (ETC) launcher for the acceleration of multikilogram-size projectiles to hypervelocity

is proposed. The novel launcher concept utilizes the hot hydrogen gas generated by the chemical interaction between water and aluminum in order to accelerate the projectiles to a thermal velocity close to that of the light gas. This interaction is triggered by the Joule heating of the aluminum wire in water. Two possible designs for the accelerator concept are considered in detail. Further acceleration of the projectile near the muzzle is also discussed.

Author

A92-10376
A DC HIGH-CURRENT LOW-ENERGY ELECTRON BEAM GUN
TADASHI OHGO (Fukuoka University of Education, Munakata, Japan), TAMIO HARA, MANABU HAMAGAKI (Institute of Physical and Chemical Research, Wako, Japan), KAZUSHIGE ISHII (National Institute for Fusion Science, Nagoya, Japan), and MASAMOTO OTSUKA (Kansai Medical University, Hirakata, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Oct. 15, 1991, p. 4050-4052. refs
Copyright

A dc high-current and low-energy electron beam gun has been developed. The maximum electron beam current is 63 A for an accelerating energy of 140 eV. The maximum ratio of the beam current to the discharge current is 78 percent. The ion current, which is extracted from the helium plasma produced by the electron beam, is 12.3 A. This value corresponds to the current density of about 7 A/sq cm, which is the highest value among the ion sources in steady operation. The electron density of the plasma is estimated from the ion saturation current to be about $4.6 \times 10^{13}/\text{cm}^3$, which corresponds to the degree of ionization of 21 percent. This gun will open the way for many electron beam applications.

Author

A92-10394
SKIN EFFECT IN A HIGH-TC FLUX-FLOW
SUPERCONDUCTING WIRE

YOICHI ANDO and SHIRABE AKITA (Central Research Institute of Electric Power Industry, Komae, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Oct. 15, 1991, p. 4415-4420. refs
Copyright

As a candidate for a low ac-loss bulk power transmission cable, a high-Tc superconducting wire in a flux-flow state, which is called a flux-flow superconductor here, is theoretically studied. The current distribution inside the wire and the ac loss are numerically calculated to investigate the influence of the skin effect in such a nonlinear system. The ac loss is enhanced by the skin effect, and it is found that the amount of this enhancement can be scaled by a nondimensional parameter which depends not only on the frequency and the radius of the wire but also on the peak current. As a means to reduce the ac loss in the presence of the skin effect, it is shown to be effective to divide the wire into many coaxial layers and to set the current distribution between the layers artificially. It is also shown that, if an optimized current distribution is settled between the layers, the ac loss can be reduced to a smaller value than that for a nondivided wire neglecting the skin effect.

Author

A92-10995
FULLY MONOLITHIC 22 GHZ-BAND ALGAS/GAAS HBT
OSCILLATOR

N. HAYAMA, J. SHIMIZU, and K. HONJO (NEC Corp., Kawasaki, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Sept. 26, 1991, p. 1862, 1863. refs
Copyright

The large signal design and performance is described for the fully monolithic 22 GHz-band oscillator implemented using a selfaligned $\text{AlGaAs}/\text{GaAs}$ heterojunction bipolar transistor. The developed oscillator has exhibited an output power of 6.2 dBm at 22.16 GHz with a collector efficiency of 9.5 percent, and phase noise of -78 dBc/Hz at 100 kHz off-carrier under free-running conditions. These results were in good agreement with the designed results obtained using a harmonic balance simulator. Author

A92-11297

FABRICATION OF VARIABLE-THICKNESS BRIDGE USING YBCO THIN FILM

CHAN H. PARK, TADAYUKI KOBAYASHI, and TOSHINARI GOTO (University of Electro-Communications, Chofu, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 1, 1991, p. L1556-L1558. Research supported by MOESC. refs Copyright

In-situ-grown YBCO thin films were prepared on an MgO substrate by RF magnetron sputtering with a dc-biased substrate holder using a stoichiometric $\text{YBa}_2\text{Cu}_3\text{O}(y)$ target. The variable-thickness bridges with the bridge length of 80 nm-200 nm were fabricated in these films by means of photolithography and slant evaporation techniques. The current-voltage characteristics of the bridge in RF radiation show the structure of the RF-induced steps over a wide temperature range. Author

A92-11298

FABRICATION OF $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}(8+\delta)$ / $\text{Bi}_2\text{Sr}_2\text{Nd}_1\text{Cu}_2\text{O}(8+\delta)$ / $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}(8+\delta)$ JOSEPHSON JUNCTIONS

KOICHI MIZUNO and KENTARO SETSUNE (Matsushita Electric Industrial Co., Ltd., Central Research Laboratories, Moriguchi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 1, 1991, p. L1559-L1561. refs Copyright

Sandwich-type Josephson junctions using Bi-based oxide barriers were successfully fabricated. $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}(8+\delta)$ films were used for superconducting electrodes, and $\text{Bi}_2\text{Sr}_2\text{Nd}_1\text{Cu}_2\text{O}(8+\delta)$ films were used for the barrier layers. Each material had the same crystalline structure. The resistivity values of the $\text{Bi}_2\text{Sr}_2\text{Nd}_1\text{Cu}_2\text{O}(8+\delta)$ films were rather high compared to those of ordinary metals or $\text{Bi}_2\text{Sr}_2\text{Cu}_1\text{O}(6+\delta)$. The junctions clearly exhibited S/N/S-type characteristics. The ac Josephson effect of the I-V curves under the irradiation of microwaves around 12 GHz was observed. Author

A92-11300

FABRICATION OF THIN SILICON WIRES BY ANISOTROPIC WET ETCHING OF SOI STRUCTURES

KAZUO ITOH, KAZUAKI IWAMEJI, and YOSHISATO SASAKI (Gumma University, Kiryu, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 1, 1991, p. L1605-L1607. refs Copyright

A fabrication method of thin single-crystalline silicon wires on SiO_2 is reported. The wires are fabricated through anisotropic wet etching of (110) and (100) SOI wafers. The method is considered to have the potential for forming ultranarrow wires by careful control of the etching conditions. O.G.

A92-12281

ULTRAHIGH-SPEED HEMT LSI TECHNOLOGY FOR SUPERCOMPUTER

MASAYUKI ABE and TAKASHI MIMURA (Fujitsu Laboratories, Ltd., Atsugi, Japan) IEEE Journal of Solid-State Circuits (ISSN 0018-9200), vol. 26, Oct. 1991, p. 1337-1344. refs Copyright

The current status of high electron mobility transistor (HEMT) technology at Fujitsu for high-performance VLSI is presented, focusing on device performance in the submicrometer dimensional range and the HEMT LSIs implemented in supercomputer systems. The HEMT is a very promising device for ultrahigh-speed LSI/VLSI applications because of the high-mobility GaAs/AlGaAs heterojunction structure. A 1.1 K-gate bus-driver logic LSI has been developed to demonstrate the high-speed data transfer in a high-speed parallel processing system at room temperature, operating at 10.92 Gflops. A cryogenic 3.3 K-gate random number generator logic LSI with maximum clock frequency of 1.6 GHz has also been developed to demonstrate the high-clock-rate system operations at liquid-nitrogen temperature. For VLSI level complexity, a HEMT 64-kb static RAM with 1.2-ns access operation and a 45

K-gate array with 35-ps logic delay have been developed operating at room temperature, demonstrating the high performance required for future high-speed computer systems. I.E.

A92-13105

THIN FILM PREPARATION AND DEVICE APPLICATIONS OF EPITAXIAL MgO/NbN MULTILAYERS

K. HAMASAKI, A. IRIE, Z. WANG, T. YAMASHITA (Nagaoka University of Technology, Japan), and K. WATANABE (Tohoku University, Sendai, Japan) IN: Advances in cryogenic engineering - Materials. Vol. 36, pt. A. New York, Plenum Press, 1990, p. 377-383. refs Copyright

The optimum deposition conditions and the surface and interface morphologies of ultrathin (less than 10 nm) NbN films are investigated with the aim of producing high-Tc, low-resistivity NbN films with good surface morphology under conditions suitable for all-NbN Josephson junction fabrication. Results of a recent study on the deposition of oriented MgO films by RF sputtering from single crystals and hot-pressed MgO targets and on the epitaxial growth of MgO/NbN multilayers are examined. It is noted that, although the conditions of MgO/NbN multilayer preparation are still unoptimized, all-NbN nanobridges with good Josephson response in the presence of magnetic fields and millimeter and submillimeter radiations have been successfully fabricated. V.L.

A92-13117

FABRICATION AND PROPERTIES OF FLEXIBLE TAPES OF HIGH-TC $\text{Bi}(\text{Pb})\text{-Sr-Ca-Cu-O}$ SUPERCONDUCTORS

KAZUMASA TOGANO, HIROAKI KUMAKURA, D. R. DIETDERICH, HIROSHI MAEDA (National Research Institute for Metals, Tsukuba, Japan), EIJI YANAGISAWA, and TSUYOSHI MORIMOTO (Asahi Glass Research Center, Yokohama, Japan) IN: Advances in cryogenic engineering - Materials. Vol. 36, pt. A. New York, Plenum Press, 1990, p. 587-592. refs Copyright

The effect of processing conditions on the microstructure and properties of high-Tc superconducting flexible tapes is examined with reference to experimental results obtained for tapes of high-Tc $\text{Bi}(\text{Pb})\text{-Sr-Ca-Cu-O}$ superconductors fabricated by a combination of doctor blading and rolling processes. A zero-resistance state was achieved at temperatures as high as 107 K. The highest Jc obtained so far is about 2000 A/sq cm at 77 K in a zero magnetic field. The tape is sufficiently flexible to be bent into a small diameter ring corresponding to the diameter of a small superconducting magnet without breakage and degradation of Jc. V.L.

A92-13284

ELECTRICAL PROPERTIES OF $\text{Au}/$ AND $\text{YBa}_2\text{Cu}_3\text{O}(7-x)/\text{SrTi}(1-y)\text{Nb}(y)\text{O}_3$ DIODES

A. YOSHIDA, H. TAMURA, K. GOTOH, H. TAKAUCHI, and S. HASUO (Fujitsu, Ltd., Atsugi, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Nov. 1, 1991, p. 4976-4981. Research supported by New Energy and Industrial Technology Development Organization. refs Copyright

Electrical properties of $\text{Au}/$ and $\text{YBa}_2\text{Cu}_3\text{O}(7-x)/\text{SrTi}(1-y)\text{Nb}(y)\text{O}_3$ heterojunctions were studied by measuring their capacitance-voltage, current-voltage, and conductance-voltage characteristics. The heterostructures were made by depositing Au or $\text{YBa}_2\text{Cu}_3\text{O}(7-x)$ films on $\text{SrTi}(1-y)\text{Nb}(y)\text{O}_3$ substrates. The results of the capacitance-voltage measurement indicated that there was an interfacial layer having a dielectric constant lower than that of bulk SrTiO_3 at the Au/SrTiO_3 and $\text{YBa}_2\text{Cu}_3\text{O}(7-x)/\text{SrTiO}_3$ interfaces. The current-voltage characteristics of $\text{Au}/\text{SrTi}(1-y)\text{Nb}(y)\text{O}_3$ diodes with substrate Nb concentrations of 0.05 and 0.005 wt pct matched characteristics normally associated Schottky junctions and had a large ideality factor, n, consistent with the low-dielectric-constant interfacial layers. When the carrier concentration of the n- SrTiO_3 substrate was 2×10^{19} /cu cm, the Au and $\text{YBa}_2\text{Cu}_3\text{O}(7-x)$ junctions showed interfacial-layer tunneling characteristics. The

YBa₂Cu₃O(7-x) junctions exhibited two peaks in their conductance-voltage relations whose peak structures relies on the superconducting state density in YBa₂Cu₃O(7-x) films. Author

A92-13661

YBA₂CU₃O(7-DELTA) ANGLE GRAIN BOUNDARY JUNCTION ON SI BICRYSTAL SUBSTRATE

JIAN CHEN, YOSHIHARU MUTOH, YOSHIHIKO HIROTSU (Nagaoka University of Technology, Japan), TSUTOMU YAMASHITA, KENSUKE NAKAJIMA (Tohoku University, Sendai, Japan), HAJIME SUZUKI, HIDEYUKI KUROSAWA (Riken Co., Technological Research Center, Kumagaya, Japan), HIROAKI MYOREN, and YUKIO OSAKA (Hiroshima University, Higashi-Hiroshima, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 1964-1968. refs

Copyright

Si bicrystal substrates with angle grain boundaries (AGB) have been fabricated for the first time by a diffusion bonding technique using the hot-press method. YBa₂Cu₃O(7-delta) (YBCO) epitaxial thin films are grown on the Si bicrystal substrates with yttria (Y₂O₃) and yttria-stabilized zirconia (YSZ) buffer layers by rf magnetron sputtering. The properties of bridge-type junctions patterned by excimer laser have been studied from 4.2 K to 77 K and by microwave irradiation. It is found that the critical current density of the AGB junction ($J_{sub c exp A}$) is always less than that of either bridge made on single-crystal grains ($J_{sub c exp G}$). The effects of the temperature and microwave radiation show that the properties of the bridges on the grains are limited by flux creep. In contrast, the properties of the AGB junction with the angle larger than 10 deg show the Josephson effect. Author

A92-13680

AN EQUIVALENT CIRCUIT OF A SLOT IN RADIAL LINE SLOT ANTENNAS

JUN-ICHI TAKADA, MAKOTO ANDO, and NAOHISA GOTO (Tokyo Institute of Technology, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Sept. 1991, p. 2922-2928. refs (Contract MOESC-63420032; MOESC-02952154)

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A radial line slot antenna (RLSA) is a high-gain and high-efficiency planar antenna for DBS reception and VSAT terminals. To generalize the slot design of RLSA, it is necessary to estimate the radiation, reflection and the transmission characteristics of a slot. This paper presents an equivalent circuit of a slot on radial waveguide. A periodic structure model is used in the moment method analysis, to simulate the slot coupling in rotationally symmetric antenna operation in the oversized radial line. Radiation and reflection coefficients are expressed in the S-matrix form; the slot length dependence of the matrix element is discussed. Author

A92-14026

THE CONCEPT OF A FUTURE DATA AND INFORMATION SYSTEM FOR SPACE APPLICATIONS AND ELECTROOPTICS

HIROSHI ANEGAWA and KENJI NISHIYAMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 438-449. In Japanese. refs

The concept of a data and information system for space applications is presented. The trends of spacecraft design, orbital reconfiguration, and data transmission are discussed. A comparison among three generations of data processing systems is given. Electrooptics for space applications is addressed including laser communication between spacecraft. Y.P.Q.

A92-14176

EPITAXIAL GROWTH OF ZNMGSSE ON GAAS SUBSTRATE BY MOLECULAR BEAM EPITAXY

HIROYUKI OKUYAMA, KAZUSHI NAKANO, TAKAO MIYAJIMA, and KATSUHIRO AKIMOTO (Sony Corp., Research Center, Yokohama, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 15, 1991, p. L1620-L1623. refs

Copyright

A new material, ZnMgSSe, is proposed as the cladding layer of a blue-light laser diode. Band-gap energy can be varied from 2.8 to near 4 eV, maintaining lattice-matching to a (100)GaAs substrate. The band-gap energies of MgS and MgSe (zincblende structure) are estimated to be about 4.5 eV and 3.6 eV, and the lattice constants are 5.62 Å and 5.89 Å, respectively. The refractive index of ZnMgSSe lattice-matched to GaAs is smaller than that of ZnSSe lattice-matched to GaAs. ZnMgSSe meets the requirements of the cladding layer of ZnSSe for fabricating the blue-light laser diode. Author

A92-14241

FABRICATION AND CHARACTERIZATION OF LATERAL FIELD-EMITTER TRIODES

SEIGO KANEMARU and JUNJI ITOH (Electrotechnical Laboratory, Tsukuba, Japan) (IEEE, International Vacuum Microelectronics Conference, 3rd, Monterey, CA, July 23-25, 1990) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 38, Oct. 1991, p. 2334-2336. refs

Copyright

The author fabricated a field-emitter triode with tungsten electrodes arranged laterally on a quartz glass substrate by using the photolithography and dry etching techniques. The device consists of an array of 170 field-emitter tips with a 10-micron pitch, a columnar gate, and an anode. The emission characteristics followed the Fowler-Nordheim tunneling theory. The mutual conductance was about 0.02 micro-S at an anode voltage of 300 V. The authors improved the fabrication process to obtain an emitter with an operating voltage of about 100 V. I.E.

A92-14245

SIMULATION OF GEOMETRICAL CHANGE EFFECTS ON ELECTRICAL CHARACTERISTICS OF MICROMETER-SIZE VACUUM TRIODE WITH FIELD EMITTERS

TANEMASA ASANO (Kyushu Institute of Technology, Izuka, Japan) (IEEE, International Vacuum Microelectronics Conference, 3rd, Monterey, CA, July 23-25, 1990) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 38, Oct. 1991, p. 2392-2394. refs

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Change in the electrical characteristic of a micro-vacuum triode with a field electron emitter, due to a change in physical dimension which may appear in the fabrication process, has been simulated. It has been found that the variation of the grid opening size more strongly affects the electrical characteristics of the triodes than the misalignment between the emitter tip and the center of the grid opening. It has also been found, however, that such effect can be minimized by biasing the grid at a proper voltage. Effects of grid position relative to the emitter tip have been also investigated in order to find better device geometry for high-frequency applications. I.E.

A92-14246

WEDGE-SHAPED FIELD EMITTER ARRAYS FOR FLAT DISPLAY

A. KANEKO, T. KANNO, K. TOMII (Matsushita Research Institute Tokyo, Inc., Kawasaki, Japan), M. KITAGAWA, and T. HIRAO (Matsushita Electric Industrial Co., Ltd., Moriguchi, Japan) (IEEE, International Vacuum Microelectronics Conference, 3rd, Monterey, CA, July 23-25, 1990) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 38, Oct. 1991, p. 2395-2397. refs

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The authors have investigated a field emitter for flat displays which can be precisely fabricated in a large area with simple processes. The authors discuss the simulation and the experimental results of the new type of field emitter. A wedge-shaped field emitter is constructed of an emitter and a gate on an insulating substrate. The emitter and the gate have a wedge shape in plane and are placed meeting each other with a narrow gap between them. The emitter is formed by a 500-nm-thick Mo film deposited on an Al stripe electrode layer and the gate electrode is a 200-nm-thick Cr film on a SiO₂ layer with a thickness nearly the same as that of the Mo film. The electron emission began at

about 50 V which is markedly lower than in other types of field emitters and the emission current obtained was 12 micro-A at 85 V. I.E.

A92-14661

RIGOROUS ANALYSIS OF CIRCULAR DISC RESONATORS/RADIATORS WITH IMPERFECT CONDUCTORS AND SUBSTRATES

K. ARAKI and M. NAGASHIMA (Saitama University, Urawa, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Oct. 24, 1991, p. 2061, 2062. refs
Copyright

An exact analysis of a circular disk resonator based on the Galerkin method applied in the Henkel transform domain, including all the losses in the conductor and substrate, is reported. Numerical results are shown for resonance frequencies of the TM₁₁₀ mode normalized by resonance frequencies where only radiation loss exists. C.D.

A92-14919

ELECTRON-WAVE REFLECTION BY MULTI-QUANTUM BARRIER IN N-GAAS/I-ALGAAS/N-GAAS TUNNELING DIODE

TAKESHI TAKAGI, FUMIO KOYAMA, and KENICHI IGA (Tokyo Institute of Technology, Yokohama, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Nov. 25, 1991, p. 2877-2879. refs

Copyright

For the purpose of experimentally demonstrating the enhancement of electron-wave reflection by a multiquantum barrier (MQB) consisting of multiple combinations of quarter de Broglie wavelength heterostacks, two types of n-GaAs/i-barrier/n-GaAs tunneling diodes are fabricated with a bulk Al(x)Ga(1-x)As barrier and an Al(x)Ga(1-x)As/GaAs MQB. From the current-voltage characteristic at 77 K, it is clarified that electrons are well reflected by the MQB. The potential barrier height, virtually increased by the MQB, is estimated to be about 80 meV, which is in good agreement with a theoretical expectation. Author

A92-14971

DEVELOPMENT OF SILVER-SHEATHED BISMUTH SUPERCONDUCTING WIRES AND THEIR APPLICATION

KEN-ICHI SATO, NOBUHIRO SHIBUTA, HIDEHITO MIKAI, TAKESHI HIKATA, MUNETSUGU UYEYAMA, and TAKESHI KATO (Sumitomo Electric Industries, Ltd., Osaka, Japan) (Joint Magnetism and Magnetic Materials-Intermag Conference, 5th, Pittsburgh, PA, June 18-21, 1991, Proceedings. A92-14952 03-76) Journal of Applied Physics (ISSN 0021-8979), vol. 70, pt. II, Nov. 15, 1991, p. 6484-6488. refs
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This paper describes the state of the art of high-T_c superconducting wires using a combination of bismuth high-T_c phase and powder-in-tube technique. Maximum J_c at 77.3 K reached to 53,700 A/sq cm in a zero magnetic field, 42,300 A/sq cm at 0.1 Tesla and 12,000 A/sq cm at 1 Tesla. Prototypes, such as a 1000 A carrying conductor at 77.3 K, a 1000 Gauss coil at 77.3 K, and a super-high field coil at 4.2 K were made and tested successfully. Author

A92-14974

MULTIVIBRATOR TRANSISTOR SWITCH MODULE USING A HIGH-TEMPERATURE SUPERCONDUCTING CORE

T. UCHIYAMA, T. SHIBATA, M. MAKINO, and K. MOHRI (Nagoya University, Japan) (Joint Magnetism and Magnetic Materials-Intermag Conference, 5th, Pittsburgh, PA, June 18-21, 1991, Proceedings. A92-14952 03-76) Journal of Applied Physics (ISSN 0021-8979), vol. 70, pt. II, Nov. 15, 1991, p. 6498-6500. refs

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A transistor switching module based on the Royer oscillator-type magnetic multivibrator is presented in which a high-temperature superconductor thin disk core, with four coils tightly set around it, is connected with two switching transistors. This Royer-type module has superior properties such as pulse-triggered switching; moreover, oscillation of this circuit starts within a half cycle, while

parametric oscillation switching modules need several cycles to turn on. The module has a total switching time of less than 0.4 microsec, which is about 1 percent that of the Royer circuit using an amorphous core. C.D.

A92-14980

ANISOTROPIC ND-FE-B THIN-FILM MAGNETS FOR MILLI-SIZE MOTOR

S. YAMASHITA, J. YAMASAKI (Kyushu Institute of Technology, Kitakyushu, Japan), M. IKEDA, and N. IWABUCHI (Yaskawa Electric Manufacturing Co., Ltd., Research Laboratory, Kitakyushu, Japan) (Joint Magnetism and Magnetic Materials-Intermag Conference, 5th, Pittsburgh, PA, June 18-21, 1991, Proceedings. A92-14952 03-76) Journal of Applied Physics (ISSN 0021-8979), vol. 70, pt. II, Nov. 15, 1991, p. 6627-6629. refs
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In order to apply Nd-Fe-B sputtered-film magnetics to actuators or motors, the effects of film composition, substrate materials, and film thickness on the magnetic properties and structure were investigated. The anisotropic film magnets could be deposited at a substrate temperature of 460 C on metallic substrates. The c-axis orientation tended to be disordered gradually with film thickness. Using 20-micron thick film magnets, a small-scale motor was fabricated and a torque of 0.8 g mm was obtained at a rotational speed of 3000 rpm. C.D.

A92-16288

ANALYSIS OF A CAVITY-BACKED ANNULAR SLOT ANTENNA WITH ONE POINT SHORTED

HISASHI MORISHITA, KAZUHIRO HIRASAWA, and KYOHEI FUJIMOTO (Tsukuba, University, Japan) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 39, Oct. 1991, p. 1472-1478. refs

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Analysis of a cavity-backed annular slot antenna with one point shorted is performed experimentally and theoretically. Resonance frequencies, bandwidths, and radiation patterns are studied with respect to slot width, cavity depth, and slot shorting position. In the theoretical analysis, the method of moments is applied to find the magnet current on the slot, and the Green's function for the field inside the cavity has been newly derived. By selecting a slot shorting position, circular polarization, and a bandwidth of more than 10 percent, the voltage standing-wave ratio (VSWR) not greater than 2 for the input impedance is obtained. I.E.

A92-16436

NOVEL STRUCTURE MQW ELECTROABSORPTION MODULATOR/DFB-LASER INTEGRATED DEVICE FABRICATED BY SELECTIVE AREA MOCVD GROWTH

M. AOKI, H. SANO, M. SUZUKI, M. TAKAHASHI, K. UOMI, and A. TAKAI (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Nov. 7, 1991, p. 2138-2140. refs

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A novel structure electroabsorption modulator/DFB laser integrated device is proposed and demonstrated. Both functional devices consist of MQW structures with different quantum energy levels, which are automatically formed in the same MOCVD run by using a selective area growth technique. A fundamental modulation with a 12.6 dB extinction ratio is demonstrated. Author

A92-16437

ER(3+)-DOPED MULTICOMPONENT GLASS CORE FIBRE AMPLIFIER PUMPED AT 1.48 MICRON

M. OHASHI and K. SHIRAKI (NTT, Transmission Systems Laboratories, Tokai, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Nov. 7, 1991, p. 2143-2145. refs

Copyright

An excellent fiber amplifier of Er(3+)-doped silica fiber with a multicomponent core composed of Na₂O, CaO, Al₂O₃, SiO₂, and Er(3+), is realized. A maximum signal gain of 37 dB for a pump

power of 23 mW at 1.48 micron and the gain coefficient of 3.5 dB/mW are attained. Author

A92-17410
BIMORPH TYPE ACTUATORS USING LEAD ZINC
NIOBATE-BASED CERAMICS

YOU KONDOH and TOMIO ONO (Toshiba Corp., Research and Development Center, Kawasaki, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2260-2263. refs

Copyright

The properties of bimorph-type actuators (such as hysteresis, creep, and temperature coefficient) that were manufactured from several kinds of lead zinc niobate (PBZM)-based ceramics were investigated. It was found that, in the PBZM-based ceramics, the relative dielectric constant affected the electrostrictive constant, but had little effect on hysteresis, creep, or the temperature coefficient near room temperature. I.S.

A92-17411
ACTUATOR CHARACTERISTICS OF PB(ZRTI)O3
COMPOSITION NEAR MORPHOTROPIC PHASE BOUNDARY

MASAKATSU KIYOHARA, KEN-ICHI KATO, KIYOSHI HAYAMA, and AKASHI FUNAMOTO (Toto, Ltd., Basic Research Laboratory, Chigasaki, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2264-2266. refs

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Piezoelectric actuator characteristics such as strain characteristics under dc voltage, temperature dependence, load characteristics and durability under repetitious dc voltage application were investigated in the (Pb_{0.845}-Sr_{0.05}-Ba_{0.105})(Zr_xTi_(1-x)/0.95-Sn_{0.045}-Nb_{0.005})O₃ series (x between values 0.49 and 0.55). The piezoelectric characteristics changes markedly owing to the difference in crystal structure. The compositions in the tetragonal phase are superior for actuator applications.

Author

A92-17413
GAP STRUCTURE MULTILAYER PIEZOELECTRIC ACTUATOR

KOICHI KANAYAMA, HIROSHI MASE, HIROAKI SAIGO, HIROYUKI NAGAYAMA, HIROYASU YAMAOKA, and YOSHIHISA USHIDA (Mitsui Petrochemical Industries, Ltd., High Performance Materials and Products Research Laboratories, Sodogaura, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2281-2284. refs

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A new multilayer piezoelectric actuator, in which gaps were formed at the ends of the internal electrodes, was manufactured by a cofiring method. Its high endurance has been confirmed both by a 500-million-pulse driving test and by 120-V dc voltage-applying life test for 500 hrs under high humidity. Large displacement was achieved in a wide temperature range up to 135 C by using newly developed piezoelectric ceramics. Author

A92-17573
ALGAAS/GAAS AND ALGAAS/INGAAS/GAAS HIGH
ELECTRON MOBILITY TRANSISTORS GROWN BY
METALORGANIC VAPOR PHASE EPITAXY USING
TERTIARYBUTYLARSINE

TOSHIHIDE KIKKAWA, TATSUYA OHORI, EIZOU MITANI, MASAHIRO SUZUKI, HITOSHI TANAKA, and JUNJI KOMENO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Oct. 1, 1991, p. L1718-L1721. refs

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A92-18427

INGAASP/INP OPTOELECTRONIC EXCLUSIVE-OR (XOR)
GATE OPERATING WITH OPTICAL INPUTS AND OUTPUTS

H. ADACHI, K. MATSUDA, T. CHINO, and J. SHIBATA (Matsushita Electric Industrial Co., Ltd., Osaka, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Nov. 1991, p. 1013-1015. refs

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An optoelectronic exclusive-OR (XOR) gate operating with optical inputs and outputs was fabricated. The gate is based on an optoelectronic bistable switch consisting of a light emitting diode (LED) and a heterojunction phototransistor (HPT). The inverter function indispensable for the XOR logic is attained optically by connecting an additional HPT to the bistable switch in parallel. Successful operation of the XOR logic was demonstrated. I.E.

A92-18437

OBSERVATION OF FIELD-INDUCED REFRACTIVE INDEX
VARIATION IN QUANTUM BOX STRUCTURE

TAKUYA AIZAWA, KAZUHIKO SHIMOMURA, SHIGEHISA ARAI, and YASU HARU SUEMATSU (Tokyo Institute of Technology, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Oct. 1991, p. 907-909. Research supported by MOESC and TEPCO Research Foundation. refs

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An electric-field-induced refractive index variation in a GaInAs/InP five-layered quantum box structure was observed for the first time. The wavelength dependence of the refractive index variation was measured to confirm the quantum box effect. The size of the GaInAs/InP quantum box was estimated to be (22-30 nm)-squared with the thickness of 7.5 nm, from the spectral property of the field-induced refractive index variation. The maximum value of the refractive index variation in the quantum box was evaluated to be 7 percent around 1.52 microns wavelength at an applied electric field of $8 \times 10 \exp 4$ V/cm. I.E.

A92-18846

CONTROL OF MICROSCOPIC SUPERCONDUCTING CHANNEL
BY PROXIMITY EFFECT

HIROO TOTSUJI (Okayama University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 30, 1991, p. 3628-3630. refs

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The feasibility of inducing the transition of the thin superconducting channel from the superconducting to the normal state and vice versa, by applying voltage to an electrode is investigated by analyzing simple 1D solutions of the equation for the order parameter in the dirty limit. It is shown that it is possible to control the superconducting channel by the proximity effect. Advantages of this method in the application to 3D devices are discussed. I.S.

A92-19052

OPTICAL CONTROL OF WAVE PROPAGATION IN
MICROSTRIP-SLOT LINES AT D BAND

M. TSUTSUMI, H. SHIMASAKI (Kyoto Institute of Technology, Japan), and G. B. MORGAN (Cardiff, University College, Wales) IEE Proceedings, Part H - Microwaves, Antennas and Propagation (ISSN 0950-107X), vol. 138, Dec. 1991, p. 527-531. refs

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The dispersion relationship for microstrip-slot lines are analysed by the spectral domain method and evaluated numerically as a function of plasma density for an optically induced plasma. The frequency range considered corresponds to the W and D range, and the microstrip is realized on high-resistivity silicon. The experimental work was undertaken at frequencies ranging from 90 to 170 GHz using 5 kilo-ohms cm silicon substrates with different strip widths irradiated by light emitting diodes radiating at a wavelength of 820 nm. Optical control was confirmed by measuring the change in propagation loss resulting from the illumination. A wave attenuation of 10 dB was determined for a line of length of 30 mm, and a plasma relaxation time of 120 microsec was

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measured at 137 GHz. Applications of this line are briefly discussed. Author

A92-19138

PROPOSAL AND ANALYSIS OF QUANTUM-INTERFERENCE HIGH-SPEED ELECTRON DEVICES USING METAL-INSULATOR HETEROSTRUCTURE

TOMOAKI SAKAGUCHI (JR Tokai, Ltd., Japan), MASAHIRO WATANABE, and MASAHIRO ASADA (Tokyo Institute of Technology, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3326-3333. Research supported by MOESC and Research Center for Ultra-High-Speed Electronics. refs Copyright

A novel transistor with metal and insulator layers is proposed which is based on the wave nature of high-velocity ballistic electrons. The metal-insulator combination makes it possible to obtain high current density, low resistivity, and small capacitance. Since the metal-insulator combination has an extremely high conduction band discontinuity, strong quantum interference can be obtained. It is shown that this device has the potential of attaining subpicosecond response. The device is considered to be suitable for a variety of ultra-high-speed signal processing and logic applications. O.G.

A92-19375

DEVELOPMENT OF A SECOND CYCLOTRON HARMONIC GYROTRON OPERATING AT SUBMILLIMETER WAVELENGTHS

T. IDEHARA, T. TATSUKAWA, I. OGAWA, H. TANABE, T. MORI, S. WADA (Fukui University, Japan), G. F. BRAND, and M. H. BRENNAN (Sydney, University, Australia) Physics of Fluids B (ISSN 0899-8221), vol. 4, Jan. 1992, p. 267-273. Research supported by MOESC and Murata Science Foundation. refs Copyright

The development of a high-frequency, step-tunable gyrotron operating at submillimeter wavelengths is described. The gyrotron design was optimized for operation at the second harmonic of the electron cyclotron frequency in the TE261 cavity mode, whose resonant frequency is 384 GHz. Experimental results show that second harmonic operation can occur without mode competition as long as the beam current is low (0.8 A or less), but as the current is increased, the fundamental TE231 cavity mode increases and eventually suppresses the second harmonic. The competition between the two modes is studied in detail. The starting current for second harmonic operation is also studied experimentally and compared with calculated results. Author

A92-21428

GAAS/ALGAAS MULTIQUANTUM WELL IR DETECTORS

M. KOBAYASHI, M. NAKANISHI, Y. NOTANI, K. AONO, Y. KOMINE, and W. SUSAKI (Mitsubishi Electric Corp., Itami, Japan) IN: Infrared technology XVI; Proceedings of the Meeting, San Diego, CA, July 11-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 46-51. refs Copyright

GaAs/Al(0.31)Ga(0.69)As IR detector of multi-quantum well structure with a single bound state in a GaAs well have been fabricated. The peak wavelength of spectral responsivity at 77 K was 8.3 microns. The measured responsivities were 20 V/W for A-type detectors, 65 V/W for B-type detectors, and 130 V/W for C-type detectors. The corresponding specific detectivities at peak wavelength were 2.8×10^9 cm² Hz/W, 2.7×10^9 cm² Hz/W, and 2.7×10^9 cm² Hz/W, respectively. These values are about one order lower than those of conventional CdHgTe photoconductive devices. C.D.

A92-21432

COMPACT 128 INSB FOCAL PLANE ASSEMBLY FOR THERMAL IMAGING

H. FUJISADA (Electrotechnical Laboratory, Tsukuba, Japan), M. NAKAYAMA, and A. TANAKA (Hamamatsu Photonics, Japan) IN: Infrared technology XVI; Proceedings of the Meeting, San Diego,

CA, July 11-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 80-91. refs Copyright

A compact focal plane assembly which consists of a linear array of 128 InSb photodiodes and two Si-MOSFET multiplexer IC chips has been developed. The design and fabrication of the photodiode array, the readout circuit on the focal plane, the hybrid packaging, and the operation of the focal plane assembly are described. A small InSb pixel size of 60 microns is used, and the total length of the array is 7.60 mm. A measured radiometric resolution of 0.04 K NE Delta T is obtained for a 300 K target with a simple circuit configuration under the TV-compatible operation. C.D.

A92-21496

TOWARD THE REALIZATION OF A JOSEPHSON COMPUTER

S. HASUO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Science (ISSN 0036-8075), vol. 255, Jan. 17, 1992, p. 301-305. refs Copyright

Current LSI circuits built with Josephson junctions are substantially faster than semiconductor circuits, despite much lower integration density. While current visualizations of the Josephson computer immerse the entire system (encompassing CPU, cache memory, and main memory) in a cryogenic environment, the present Josephson LSI chips are still experimental and cannot be directly mass-produced. Attention is accordingly given to a hybrid experimental system employing both Josephson and semiconductor devices. The cryostat design used relieves the transmission bottleneck between the Josephson circuits and room-temperature peripherals. O.C.

A92-21727

AMORPHOUS FLUOROPOLYMER FILMS FOR SUPERCONDUCTIVE MICROWAVE COMPONENTS USING HIGH-TC SUPERCONDUCTING FILMS

YASUHIRO NAGAI, NAOBUMI SUZUKI (NTT, Interdisciplinary Research Laboratories, Tokai, Japan), MAKOTO SATO, and TSUNEO KONAKA (NTT, Telecommunication Field Systems Research and Development Center, Tokai, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Nov. 1991, p. 2751-2755. refs Copyright

This paper describes the influence of amorphous fluoropolymer (AF) film on the properties of high-Tc superconductive microwave components, when it is used for surface protection and as a spacer. It is found that AF film can protect EuBaCuO and TlBaCaCuO superconducting film from dampness, thus maintaining the properties of a microstrip resonator for at least 1000 h. The AF protection has almost no effect on properties such as temperature dependence and unloaded-Q values in high-Q microwave components. Additionally, the use of AF film as a spacer in a strip-line structure reduces the influence of spacing on the effective dielectric constant and characteristic impedance. Author

A92-22047

VISIBLE ELECTROLUMINESCENCE FROM POROUS SILICON

NOBUYOSHI KOSHIDA and HIDEKI KOYAMA (Tokyo University of Agriculture and Technology, Koganei, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 20, 1992, p. 347-349. refs Copyright

It is demonstrated that photoluminescent porous Si (PS) layers exhibit definitely visible electroluminescence (EL). The PS layers were formed by anodization of single-crystal nondegenerate p-type Si wafers in an HF solution. The experimental EL cells are of the form semitransparent metal/PS layer/p-type Si/Al electrode. These cells show a rectifying junction behavior. When the forward current density reaches a certain value, stable visible (orange) light is uniformly emitted through a semitransparent electrode. A possible explanation of this is the radiative transition due to electron and hole injection into quantized states in PS. Author

A92-22076**SI METAL INSULATOR SEMICONDUCTOR TUNNEL EMITTER TRANSISTOR (SI MIS TET)**

TOMOMI YOSHIMOTO, TOSHIMITI SAKATA (Hokkaido Tokai University, Sapporo, Japan), KAZUHIKO MATSUMOTO, and KUNIHIRO SAKAMOTO (MITI, Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2012-L2014. refs Copyright

The fabrication of a Si metal-insulator-semiconductor tunnel emitter transistor (Si MIS TET) is described, that has a base formed by an inversion hole layer and can be operated in a small current region. The base thickness, which corresponds to that of the inversion layer, is of the order of a few tens of angstroms (i.e., more than 100 times thinner than that of the conventional Si bipolar transistor). The results of measurements of the dependence of the base current on the emitter base bias in Gummel plots confirm the prediction of Simmons and Taylor (1986) that the inversion hole layer indeed functions as a base of the Si MIS TET. The maximum common emitter mode current gain of 5 was obtained at room temperature. I.S.

A92-22077**FABRICATION OF METAL-INSULATOR-SEMICONDUCTOR DEVICES USING POLYCRYSTALLINE DIAMOND FILM**

HIDEO KIYOTA, KEN OKANO, TATSUYA IWASAKI, HIROSHI IZUMIYA, YUKIO AKIBA, TATEKI KUROSU, and MASAMORI IIDA (Tokai University, Hiratsuka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2015-L2017. refs Copyright

The fabrication of metal-insulator-semiconductor (MIS) devices from a polycrystalline diamond film doped with boron is described together with the electrical characteristics of these devices. Results of the capacitance-voltage characteristics measurements showed that the MIS capacitance varied as a function of the bias voltage applied between the gate and the substrate. A MIS field-effect transistor fabricated by the method used for preparing MIS has demonstrated transistor operation capabilities at room temperature, suggesting the feasibility of using polycrystalline diamond films as electronics material. I.S.

A92-22078**RESONANT TUNNELING IN A NOVEL COUPLED-QUANTUM-WELL BASE TRANSISTOR**

TAKAO WAHO, KOICHI MAEZAWA, and TAKASHI MIZUTANI (NTT, LSI Laboratories, Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2018-L2020. refs Copyright

Resonant tunneling in a novel coupled-quantum-well (CQW) base transistor is investigated. The CQW-base structure is confirmed through secondary ion mass spectroscopy and transmission electron microscopy. Transconductance measurements reveal that the collector current is attributable to resonant tunneling transfer from the emitter to collector through the modified energy states in the CQW-base. Current gain as large as 5.5 is observed for the first time with respect to the resonant tunneling current. Author

A92-22081**LOW-RESISTIVITY CONTACT OF YBA₂Cu₃O_{7-x}/AL JOINT BONDED AT ROOM TEMPERATURE**

YUTAKA TAKAHASHI, EIICHI HOSOMI, and TADATOMO SUGA (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2028-L2031. Research supported by MOESC. refs Copyright

The paper reports the preparation of a low-resistivity joint between YBa₂Cu₃O_{7-x} (YBCO) and aluminum at room temperature, using the surface activation method of Suga et al. (1989), which is based on an adhesion in vacuum. Although the surface of YBCO was very rough, a tight joint was obtained.

Measurements of the interface electrical properties by the four-probe method showed contact resistance in the vicinity of 10 exp -9 ohm sq m at 77 K. The V-I measurements, however, showed that voltage had a slight positive dependence on current. I.S.

A92-22233**A NEW MODEL OF SWITCHING OPERATION IN FULLY DEPLETED ULTRATHIN-FILM CMOS/SIMOX**

YASUHIKA OMURA and KATSUTOSHI IZUMI (NTT, LSI Laboratories, Atsugi, Japan) IEEE Electron Device Letters (ISSN 0741-3106), vol. 12, Dec. 1991, p. 655-657. refs Copyright

An analysis is made of the switching performances of fabricated ultrathin-film submicrometer-gate CMOS/SIMOX ring oscillators. A time-dependent gate capacitance model is proposed to explain the switching operation mechanism. It is found that reducing the gate capacitance by full depletion of the body silicon dramatically improves the propagation delay time of CMOS/SIMOX. I.E.

A92-22255**MICROWAVE PHASE SHIFTER USING OPTICAL WAVEGUIDE STRUCTURE**

KEISUKE MATSUMOTO (Mitsubishi Electric Corp., Tokyo, Japan), MASAYUKI IZUTSU, and TADASI SUETA (Osaka University, Toyonaka, Japan) Journal of Lightwave Technology (ISSN 0733-8724), vol. 9, Nov. 1991, p. 1523-1527. Research supported by ATR Optical and Radio Communications Research Laboratories and Osaka University. refs Copyright

A microwave phase shifter with an integrated optics structure with high efficiency is discussed. The structure and the performance of the device are discussed. Microwave phase shifting was carried out using the fabricated phase shifter of titanium-diffused LiNbO₃ optical waveguides. The measured voltage to obtain halfwave phase shift for a 800 MHz microwave signal was 7.0 V. The input microwave power was 21 dBm, and the detected output microwave power was -24 dBm, so the microwave insertion loss was calculated to be approximately -45 dB. The optical insertion loss of the device was -12 dB. I.E.

A92-22282**THE AUTORESONANT PENIOTRON WITH A QUADRUPOLE INTERACTION CIRCUIT**

KUNIYOSHI YOKOO, NOBUYUKI SATO, SHOICHI ONO (Tohoku University, Sendai, Japan), and YOSHIO NAKAZATO (NEC Corp., Microwave Tube Div., Kawasaki, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 38, Dec. 1991, p. 2677-2681. Research supported by MOESC. refs Copyright

In the autoresonant peniotron interaction, all of the electrons will be able to give almost all of their kinetic energy to an electromagnetic wave, resulting in a conversion efficiency of nearly 100 percent, if the condition of $V_p = C$ is satisfied in an interaction circuit and the initial velocity ratio of electrons is correctly given as a function of the electron kinetic energy. A quadrupole circuit is proposed in which the above circuit condition is usually satisfied and the RF electric field distribution in a cross section is suitable for the peniotron interaction at the fundamental cyclotron frequency. The design procedure for the test tube with the circuit and some simulation results concerned with the tube's operation are described. I.E.

A92-23897**ANALYSIS OF OPEN-TYPE WAVEGUIDES BY THE VECTOR FINITE-ELEMENT METHOD**

MASANORI MATSUHARA, HIROTOMO YUNOKI, and AKIHIRO MARUTA (Osaka University, Suita, Japan) IEEE Microwave and Guided Wave Letters (ISSN 1051-8207), vol. 1, Dec. 1991, p. 376-378. refs Copyright

A variational expression that is suitable for waveguide analysis is proposed. In addition, a mapping technique for analyzing open-type waveguides is introduced. Any arbitrarily shaped

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waveguide can be analyzed by the finite-element method with this variational expression and the mapping technique. The dispersion characteristics of the rectangular dielectric waveguide and the microstrip line are demonstrated, and these results show the validity and usefulness of this method. I.E.

A92-23911

ENHANCEMENT OF ELECTRIC FIELD-INDUCED REFRACTIVE-INDEX VARIATION IN A (GaInAsP)/InAs/InP ASYMMETRIC MULTIPLE-QUANTUM-FILM (MQF) STRUCTURE
YASUMASA SUZAKI, SHIGEHISA ARAI, SATOSHI BABA, and MASAKI KOHTOKU (Tokyo Institute of Technology, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Dec. 1991, p. 1110-1112. Research supported by MOESC. refs
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The authors report the field-induced refractive-index variation in (GaInAsP)/InAs/InP asymmetric quantum-film structures. An enhancement of an electric field-induced refractive-index variation due to the quantum confined Stark effect was theoretically found in the GaInAsP-InAs/InP asymmetric quantum-film structure, especially in a low electric-field regime. Almost two times higher sensitivity was experimentally confirmed in a 40-period GaInAsP (8 nm)-InAs (0.3-0.6 nm)/InP (8 nm) asymmetric multiple quantum-film (MQF) structure in comparison with a symmetric one without an InAs layer at an applied electric field less than 6 V/micron. I.E.

A92-23969

A HIGHLY EFFICIENT ADAPTIVE MESH APPROACH TO SEMICONDUCTOR DEVICE SIMULATION - APPLICATION TO IMPACT IONIZATION ANALYSIS

RYO DANG (Hosei University, Tokyo, Japan), KEN'ICHI MATSUSHITA (Toshiba Corp., Kawasaki, Japan), and HIROKAZU HAYASHI (Hosei University, Tokyo, Japan) (IEEE Biennial Conference on Electromagnetic Field Computation, 4th, Toronto, Canada, Oct. 22-24, 1990) IEEE Transactions on Magnetics (ISSN 0018-9464), vol. 27, Sept. 1991, p. 4162-4165. refs
Copyright

In the simulation of semiconductor devices, it is desirable to obtain accurate results at low calculation costs. Both conditions are, however, difficult to satisfy simultaneously since high accuracy always calls for a high computation cost. This is mainly due to the need for a large mesh number for the numerical solution of governing equations. Since the adaptive mesh method is known to be effective in dealing with a tradeoff problem of this kind, the authors propose an efficient adaptive mesh-generation algorithm based on an evaluation of impact ionization discretization errors. It is found that the approach reduces computation cost at no expense in accuracy. I.E.

A92-23996

X-BAND MMIC AMPLIFIER WITH PULSE-DOPED GaAs MESFET'S

NOBUO SHIGA, SHIGERU NAKAJIMA, KENJI OTOBE, TAKESHI SEKIGUCHI, NOBUHIRO KUWATA, KEN-ICHIRO MATSUZAKI, and HIDEKI HAYASHI (Sumitomo Electric Industries, Ltd., Optoelectronics Research and Development Laboratories, Yokohama, Japan) (1991 IEEE MTT-S International Microwave Symposium and Microwave and Millimeter-Wave Monolithic Circuits Symposium, Boston, MA, June 10-14, 1991, Proceedings. A92-23988 08-33) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 39, Dec. 1991, p. 1987-1994. refs

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The design and test of an X-band monolithic four-stage low noise amplifier (LNA) with 0.5 micron-gate pulse-doped GaAs MESFETs for application in a direct broadcast satellite (DBS) converter is presented. The key feature of the research is a detailed demonstration of the advantages of using series feedback with experiments and simulations. This LNA shows an excellent input VSWR match under 1.4 as well as a noise figure of 1.67 dB and a gain of 24 dB at 12 GHz. The noise figure, the gain and VSWRs exhibit very little bias current dependence due to the exceptional

features of the pulse-doped structure FETs and the optimized circuit design. Insensitivity to bias current implies performance stability in the face of process fluctuations. Thus, the yield of chips with noise figures of less than 2.0 dB is as high as 62.5 percent, and the variations of gain and VSWR are highly uniform as well. I.E.

A92-23997

ENHANCEMENT-MODE PSEUDOMORPHIC INVERTED HEMT FOR LOW NOISE AMPLIFIER

KAZUHIKO OHMURA, HIROKI I. FUJISHIRO, MASAOKI ITOH, HIROSHI NAKAMURA, and SEIJI NISHI (Oki Electric Industry Co., Ltd., Semiconductor Technology Laboratory, Hachioji, Japan) (1991 IEEE MTT-S International Microwave Symposium and Microwave and Millimeter-Wave Monolithic Circuits Symposium, Boston, MA, June 10-14, 1991, Proceedings. A92-23988 08-33) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 39, Dec. 1991, p. 1995-2000. refs
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Characteristics of the pseudomorphic inverted HEMT (P-I-HEMT) are compared with those of the pseudomorphic HEMT. Both devices were fabricated in enhancement mode by the same process. P-I-HEMT shows a higher maximum transconductance of 590 mS/mm, and higher K-value of 600 mS/Vmm at a threshold voltage of 0 V, and better pinch-off characteristics than its counterpart. Noise characteristics of P-I-HEMT are reported. Lower noise figure (1.0 dB at 18 GHz) was obtained in the P-I-HEMT. It is concluded that the P-I-HEMT shows far better noise characteristics than the other at low drain voltage and current. I.E.

A92-24019

CIRCUIT SIMULATIONS COMBINED WITH THE ELECTROMAGNETIC FIELD ANALYSIS

TSUGUMICHI SHIBATA (NTT, Integrated Circuit Technology Laboratory, Atsugi, Japan) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 39, Nov. 1991, p. 1862-1868. refs

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In order to provide a means of rigorous simulation for wideband nonlinear microwave integrated circuits, the concept of a lumped device model is introduced into a three-dimensional, time-domain electromagnetic field analysis method. This makes it possible to perform both a circuit simulation including a nonlinear lumped devices and an electromagnetic field analysis for distributed microwave components at the same time. As an example, the generation of picosecond pulses from a nonlinear transmission line circuit is simulated. Based on the results, the features and the validity of the method are discussed in comparison with conventional circuit simulations. I.E.

A92-24560

THREE-ELEMENT STRESSED Ge:Ga PHOTOCONDUCTOR ARRAY FOR THE INFRARED TELESCOPE IN SPACE

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A photoconductor array is described and tested in terms of its performance as part of the IR Telescope in Space (IRTS). The three-element stressed Ge:Ga photoconductor array is fabricated with a stable compact stressing apparatus based on cone-disk springs, and the cut-off wavelength is established at about 180 microns. The experiments are conducted under conditions of low photon influx (approximately 100,000 photons/s) and measured at 2.0 K in a liquid-helium dewar. The product of quantum efficiency and photoconductive gain is about one with a 2-Hz chopping frequency, and the responsivity is found to be about 100 A/W. The results of the test indicate that both a slow transient response and a nonlinear response are present. The nonlinear response is

dependent on the background photon influx and suggests that the product of quantum efficiency and photoconductive gain has a time constant. C.C.S.

A92-25000

MICROSPECTROSCOPIC REFLECTANCE MEASUREMENTS OF TEXTURED POLYCRYSTALLINE SI SOLAR CELLS BY SCANNING SPECTROREFLECTOMETER

RYUCHI SHIMOKAWA, ICHIRO SAITO, KANJI KATORI (Electrotechnical Laboratory, Tsukuba, Japan), FUMIAKI NAGAMINE, and HIDEYUKI TSUBOI (JMI Institute, Tokyo, Japan) *Journal of Applied Physics* (ISSN 0021-8979), vol. 71, Feb. 1, 1992, p. 1540-1542. refs

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This is the first observation of the microspectroscopic hemispherical reflectances of polycrystalline Si solar cells by the newly-developed scanning spectroreflectometer that represents the surface texturing of small-sized grains. After studying the reflectivity of textured grains with various crystal faces, it was found that textured near-(100) grains had lower reflectivity than the other oriented textured grains where the 'near' meant crystal faces within the deviation of 15-20 deg from the defined low index faces. In addition, it was proved that, if the reflectances of grains are indirectly obtained from the unmetallized dummy wafers, the internal quantum efficiencies of grains are not correctly estimated.

Author

A92-25572

SMALL HELICAL ANTENNA MADE OF HIGH-TEMPERATURE SUPERCONDUCTING THICK FILM

KEIICHIRO ITOH (NTT, Interdisciplinary Research Laboratories, Tokai, Japan), OSAMU ISHII (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan), YASUHIRO KOSHIMOTO (NTT, Interdisciplinary Research Laboratories, Tokai, Japan), and KEIZO CHO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) *Journal of Superconductivity* (ISSN 0896-1107), vol. 4, Dec. 1991, p. 469-471. refs

Copyright

To realize a highly efficient small antenna, high-Tc superconducting thick films with zirconia cores are adopted in order to fabricate both a self-resonating small helical radiator and a quarter-wave matching circuit. The actual gain of a superconducting antenna measured at 478 MHz using a 1/70-wavelength radiator was 4.9 dB higher than that of a copper antenna.

Author

A92-25804

TEMPERATURE DEPENDENCE OF HIGH-FREQUENCY PERFORMANCE OF ALGAAS/INGAAS PSEUDOMORPHIC HEMT'S

TAKASHI MIZUTANI and KOICHI MAEZAWA (NTT, LSI Laboratories, Atsugi, Japan) *IEEE Electron Device Letters* (ISSN 0741-3106), vol. 13, Jan. 1992, p. 8-10. refs

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High-frequency measurements of 1.5-micron wavelength AlGaAs/InGaAs pseudomorphic HEMTs have been performed at temperatures ranging from 77 to 463 K. A 28 percent increase and 27 percent decrease in f_T were observed by changing the temperature from 300 to 77 K and from 300 to 463 K, respectively. The effective saturation velocity evaluated from the total delay time, $1/2\pi(f_{sub} T)$, versus reciprocal $I_{sub} DS$ relation reveals almost the same temperature dependence as $f_{sub} T$. It is also shown that the temperature dependence is similar to that of calculated velocity at high electric fields but not to that at low fields. This suggests that the temperature dependence of the HEMT performance is determined by that of the saturation velocity in the channel. I.E.

A92-25806

MOBILITY MODULATION IN A QUASI-ONE-DIMENSIONAL SI-MOSFET WITH A DUAL-GATE STRUCTURE

HIDEYUKI MATSUOKA (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), TSUNEO ICHIGUCHI (Hitachi, Ltd., Advanced

Research Laboratory, Hatoyama, Japan), TOSHIYUKI YOSHIMURA, and EIJI TAKEDA (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) *IEEE Electron Device Letters* (ISSN 0741-3106), vol. 13, Jan. 1992, p. 20-22. refs

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The electrical transport characteristics of a quasi-one-dimensional Si-MOSFET with a dual-gate structure are studied. In this device, the width of the one-dimensional channel can be changed continuously using the field effect and the intervals between one-dimensional subbands as well. By making part of the channel narrower, strong oscillations in differential conductance, even negative differential conductance, have been observed at 4.2 K, indicating the enhanced modulation of the electron mobility by inter-subband scattering suppression. I.E.

A92-26545

TRANSPORT CRITICAL CURRENT PROPERTIES OF SILVER-SHEATHED BI-BASED SUPERCONDUCTING TAPES AND COILS AT 4.2 K

NOBUHIRO SHIBUTA, MUNETSUGU UEYAMA, HIDEHITO MUKAI, and KEN-ICHI SATO (Sumitomo Electric Industries, Ltd., Osaka Research Laboratories, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 30, Dec. 15, 1991, p. L2083, L2084. refs

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Transport critical current properties of silver-sheathed bismuth-based superconducting tapes and coils were investigated at 4.2 K and up to 25 T. Critical currents showed isotropic properties when the direction of the applied magnetic field changed from parallel to the tape surface to perpendicular, i.e., J_c of $8.9 \times 10 \exp 4$ A/sq cm for H-parallel tape and $6.6 \times 10 \exp 4$ A/sq cm for H-perpendicular tape at 23 T. Critical current properties of a three-double-pancake coil were consistent with those of short specimens, showing little change at 5 to 23 T.

Author

A92-26546

ELECTROLUMINESCENCE FROM VISIBLE TO NEAR-INFRARED SPECTRAL RANGE IN BUCKMINSTERFULLERENE DIODE

MASAO UCHIDA, YUTAKA OHMORI, and KATSUMI YOSHINO (Osaka University, Suita, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 30, Dec. 15, 1991, p. L2104-L2106. refs

Copyright

Electroluminescence in Buckminsterfullerene has been reported for the first time. The Buckminsterfullerene electroluminescent diode emits visible to near-infrared light with a dull peak at around 530 nm which corresponds to the energy much larger than the band gap energy. The origin of the wide electroluminescent spectrum has also been discussed in terms of energy band scheme.

Author

A92-27881

13.3 GHZ YBCO MICROSTRIP BANDPASS FILTER

F. SUGINOSITA, K. IMAI, N. YAZAWA (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo, Japan), K. SUZUKI, S. FUJINO, T. TAKENAKA, and K. NAKAO (International Superconductivity Technology Center, Tokyo, Japan) *Electronics Letters* (ISSN 0013-5194), vol. 28, Feb. 13, 1992, p. 355-357. Research supported by New Energy and Industrial Technology Development Organization. refs

Copyright

The design and development of a 13.3 GHz three-pole Chebyshev bandpass filter using a $YBa_2Cu_3O_{7-\delta}$ thin film on an MgO substrate is described. An insertion loss of 0.2 dB at the center frequency and an unloaded Q of 2800 are obtained at 77 K. The measured characteristics are better than other high-temperature superconductor planar filters so far reported.

Author

A92-28951

BALUN NETWORKS USING COUPLED-LINE STRUCTURES

HIROSHI IWAKURA (University of Electro-Communications, Chofu,

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Japan) Microwave and Optical Technology Letters (ISSN 0895-2477), vol. 5, April 1992, p. 159-161. refs
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A balun network is described that is based on a synthesis method for the use of two interdigital-line structures and that incorporates arbitrary impedance-transformation. The interdigital-line structures are connected in parallel, and a design example of this type of balun network is described with attention given to the normalized admittances. The proposed balun networks have bandpass-filter characteristics and arbitrary transformation ratios, and they permit balanced signals to be obtained at all frequencies. C.C.S.

A92-29510

EXTRACTION OF MICROWAVE PULSES FROM A CAVITY USING A Y-Ba-Cu-O SUPERCONDUCTING FILM SWITCH

KUNIHARU TAKAHASHI, KAZUO MINAMI, KEIZO KATO (Niigata University, Japan), NORIYUKI YOSHIDA, SATOSHI TAKANO (Sumitomo Electric Industries, Ltd., Osaka Research Laboratories, Japan), and MITSURU AWANO (Tokyo Engineering University, Hachioji, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, Jan. 1992, p. 123-128. refs
Copyright

A microwave pulse source utilizing a Y-Ba-Cu-O (YBCO) superconducting film switch was studied. A YBCO thin film with T_c as high as 86 K was fabricated by a laser-ablation technique. It was installed in a cylindrical TE(111) mode cavity made of copper with a resonant frequency of 2.84 GHz. The cavity was evacuated and immersed in liquid nitrogen. The switching from superconducting to normal states in the YBCO film was made using a 1.06-micron pulsed Q-switched Nd:YAG laser with a half-time-width of 10 ns. Microwave pulses were extracted from the cavity by the YBCO film switch with a rise time of 30 ns. A microwave-pulse peak power of about 3.4 microW was obtained for the 0.2-micron film at 79 K and at an incident laser energy of 3.6 mJ. The peak power gain of the output pulse was calculated theoretically. The experimental results were found to agree with the calculated ones qualitatively. Author

A92-29535

POSSIBLE NEW STRUCTURE FOR ONE-DIMENSIONAL ELECTRON-GAS SYSTEMS BY INTERFACE BENDING OF N-ALGAS/U-GAAS HETEROJUNCTIONS

AKEMI SAWADA, TOSHIYUKI USAGAWA, SHIRUN HO, and KEN YAMAGUCHI (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, March 23, 1992, p. 1492-1494. refs
Copyright

A concept in one-dimensional electron-gas (1DEG) systems is proposed by introducing periodic bending of the heterointerface of an n-AlGaAs/u-GaAs modulation-doped structure. The carrier densities and the electrostatic potential of this system are numerically analyzed based on the classical drift-diffusion model where the doping concentration of n-Al(z)G(1-z)As is 1.0×10^{18} /cu cm, the aluminum molar fraction z of Al(z)Ga(1-z)As is 0.3, the carrier density of p-type GaAs is 1.0×10^{14} /cu cm, and the bending angle of the heterointerface is 90 deg. Electrons are more accumulated in convex regions of the u-GaAs layer than in concave ones, and the electron density in a convex region is about twice that in the conventional 2D electron-gas structure. This high density of electrons can be treated as a 1DEG channel for field-effect transistors (FETs) when the period of the bending interface is about 850 Å. Author

A92-29544

THE MERGING OF PHOTONIC AND MICROWAVE TECHNOLOGIES

DAVID POLIFKO and HIROYO OGAWA (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan) Microwave Journal (ISSN 0192-6225), vol. 35, March 1992, p. 75-78, 80. refs

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The synthesis of MMIC and fiber-optic signal-distribution

architectures for use in personal communications is addressed. A future result of this new technology could be wristwatch-sized telephone/televisions and the signal distribution networks required to service them. A conceptual drawing of a system incorporating portable terminals is presented. The concurrent utilization of both photonics and microwaves is necessary if small-sized and low-cost systems are to be realized successfully. The line-unified FET (LUFET) concept is the key to the success of the development of technologies for multifunction and reduced-size MMICs. This design integrates microwave coplanar transmission lines directly into the FET structure, thus eliminating the need for impedance matching and the use of large quarter wavelength transmission lines in some circuits. With the LUFET, circuit layout is greatly simplified, resulting in a reduced-size circuit with little or no degradation in performance over that of conventional designs. P.D.

A92-29570

MALFUNCTION OF A DIGITAL CIRCUIT CAUSED BY AN EXTERNAL ELECTROMAGNETIC FIELD. I - INDUCED VOLTAGE ON A PRINTED CIRCUIT. II - SIMULATION OF IC SIGNAL DISTURBANCE

YUKIO YAMANAKA, ATSUHIRO NISHIKATA, KAZUHIKO OHGAMI, and YASUSHI NIWATA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 37, Sept. 1991, p. 459-478. In Japanese. refs

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An investigation is conducted on the voltages induced on a signal line of a printed circuit exposed to an EM field to find a simple method to evaluate the response and malfunction, created by an external EM field, of a digital circuit. Two circuit models are introduced depending on the structure and shape of the line, a microstrip line model (straight line) and a loop model (closed line). Digital signal fluctuation resulting from voltage or current sources is also investigated to analyze the malfunctioning of digital circuits exposed to EM fields. Transient analysis for a signal voltage of a constant logic level is conducted assuming CW disturbance sources induced in the printed circuit. The numerical results for the disturbance level anticipated to create the malfunction are given. R.E.P.

A92-29687

HIGH-GAIN AND VERY SENSITIVE PHOTONIC SWITCHING DEVICE BY INTEGRATION OF HETEROJUNCTION PHOTOTRANSISTOR AND LASER DIODE

SUSUMU NODA (Kyoto University, Japan), TORU TAKAYAMA (Matsushita Electronics Corp., Electronics Research Laboratory, Itami, Japan), KIMITAKA SHIBATA, and AKIO SASAKI (Kyoto University, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, Feb. 1992, p. 305-312. refs
(Contract MOESC-03244207)

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A photonic switching device with very large gain and high sensitivity has been developed by the vertical and direct integration of a heterojunction phototransistor and a laser diode. The device switches on with very low input power of about 10 nW and emits output power of about 4 mW under continuous-wave conditions at room temperature. The minimum energy for switching on is estimated to be as low as 80 fJ. The internal optical feedback of the device is quantitatively discussed to interpret the low-power operation for the switch-on. I.E.

A92-29827#

ADVANCED MILLIMETER-WAVE TRANSPONDER

SUSUMU KITAZUME and EIJI TAKANO (NEC Corp., Yokohama, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 655-658. refs
(AIAA PAPER 92-1896) Copyright

A millimeter-wave satellite transponder with a 50 GHz/40 GHz through repeater is being developed. The key devices of the transponder are described, including the low-noise amplifier (LNA), high-power TWTA, and local oscillator. The design targets are a

noise figure of less than 3 dB at 47 GHz for the LNA, an output power of over 20 W at 43 GHz for the TWT, and a frequency stability within $\pm 1 \times 10^{-7}$ at 7 MHz for the master oscillator. C.D.

A92-30056

A 42-GHZ-BAND LOW-NOISE DOWNCONVERTER

HISAO NAKAKITA and KAZUO IMAI (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo) IEICE Transactions (ISSN 0917-1673), vol. E74, Dec. 1991, p. 4124-4130. refs

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A novel 42-GHz-band low-noise downconverter for high-definition TV (HDTV) outside broadcast links has been developed. Commercially available HEMTs are used for a low-noise preamplifier, and the parasitic reactances of bonding wires were considered when designing the input and output matching circuits for the preamplifier. A gain of 10.2 dB and a noise figure of 3.6 dB were obtained with a two-stage HEMT amplifier. The local oscillator was a parallel-feedback HEMT oscillator that directly generated a 38-GHz-band signal and was stabilized by a spherical dielectric resonator. With an output power of more than +4 dBm, a frequency drift of 2 MHz(p-p) was obtained over an ambient temperature range of 0 to 40 C. From 41.5 to 42.0 GHz, the total noise figure of the downconverter was less than 5 dB. Author

A92-30057

A 31 GHZ STATIC FREQUENCY DIVIDER USING AU/WSiN GATE GAAS MESFETS

MASAMI TOKUMITSU, KIYOMITSU ONODERA, HIROKI SUTOH, and KAZUYOSHI ASAI (NTT, LSI Laboratories, Atsugi, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Dec. 1991, p. 4136-4140. refs

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A divide-by-four static frequency divider is fabricated to evaluate the ultra-high-speed performance of Au/WSiN gate GaAs MESFETs. The divider consists of two T-type flip-flops (T-F/F) and three buffers based on low-power source-coupled FET logic (LSCFL). The divider operates up to 31.4 GHz at room temperature at power dissipation of 150 mW per T-F/F using Au/WSiN gate GaAs MESFETs well scaled down to 0.3 micron gate-length.

Author

A92-30058

STEP-RECESSED GATE STRUCTURE WITH AN UNDOPE SURFACE LAYER FOR MICROWAVE AND MILLIMETER-WAVE HIGH POWER, HIGH EFFICIENCY GAAS MESFETS

HIDEMASA TAKAHASHI (NEC Corp., Kansai Electronics Research Laboratory, Otsu, Japan), KAZUNORI ASANO (NEC Corp., VLSI Development Div., Otsu, Japan), KOUJI MATSUNAGA, NAOTAKA IWATA (NEC Corp., Kansai Electronics Research Laboratory, Otsu, Japan), AKIRA MOCHIZUKI (NEC Corp., VLSI Development Div., Otsu, Japan), and HIROMITSU HIRAYAMA (NEC Corp., Kansai Electronics Research Laboratory, Otsu, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Dec. 1991, p. 4141-4146. refs

Copyright

A new structure GaAs power FET was designed and fabricated for high output power with sufficiently high efficiency. The undoped surface layer was introduced to achieve simultaneous increase in the maximum channel current and the gate drain breakdown voltage under the large signal RF conditions. In addition the step-recessed gate structure was adopted and optimized to attain a high breakdown voltage and a high linear gain by using the 2D device simulator. A high $f(\text{max})$ of 65 GHz was obtained at the 'class-A' mode bias point, with the 0.55 micron gate length. The maximum $f(\text{max})$ of 91 GHz was obtained. The test device feasibility was tested at 12 GHz and the output power/efficiency characteristics of 4.0 W/40.1 percent with the gain of 9.2 dB have been achieved in the 'class-A' mode operation for a single chip (gate width = 8.18 mm). To the authors' knowledge, these RF power performances with high linear gain are the best data at 12 GHz.

Author

A92-31437

PHOTONIC MEMORY SWITCH CONSISTING OF MULTIPLE QUANTUM WELL REFLECTION MODULATOR AND HETEROJUNCTION PHOTOTRANSISTOR

SHINJI MATSUO, CHIKARA AMANO, and TAKASHI KUROKAWA (NTT, Opto-Electronics Laboratories, Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, March 30, 1992, p. 1547-1549. refs

Copyright

We report a photonic memory operation of an exciton absorptive reflection switch, consisting of a multiple quantum well modulator, a distributed Bragg reflector (DBR), and a heterojunction phototransistor (HPT) is reported. For the memory function, some of the bias light incident on the modulator passes through the DBR to illuminate the HPT. The state of the device is maintained after removing the input light incident on the phototransistor and is reset by removing the bias light incident on the modulator. Waveform reshaping and retiming of the disordered input pulse is also demonstrated.

Author

A92-31633

BROADBAND MILLIMETER-WAVE DETECTOR USING DIELECTRIC IMAGE LINE

KAZUO KIKUCHI (National Defense Academy, Yokosuka, Japan) Microwave and Optical Technology Letters (ISSN 0895-2477), vol. 5, May 1992, p. 239, 240. refs

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The broadband millimeter-wave detector using a dielectric image line is presented. The detector mount is fabricated by a hot carrier diode and a triangular unipole antenna with tapered angle of 16 degree, 39-degree flare angle and 3.4 mm length. A broadband millimeter-wave 32-50-GHz detector is obtained.

Author

A92-31788

FABRICATION OF HIGH QUALITY NB/ALO(X)-AL/NB JOSEPHSON JUNCTIONS. I - SPUTTERED NB FILMS FOR JUNCTION ELECTRODES

TAKESHI IMAMURA, TETSUYOSHI SHIOTA, and SHINYA HASUO (Fujitsu Laboratories, Ltd., Atsugi, Japan) IEEE Transactions on Applied Superconductivity (ISSN 1051-8223), vol. 2, March 1992, p. 1-14. refs

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The stress, surface morphology, superconducting characteristics, and crystal structure of sputtered Nb films were evaluated to judge their applicability to the Josephson-junction electrodes. The film qualities were compared between Nb films deposited by dc and RF magnetron sputtering. The authors concluded that dc-sputtered Nb films are more suitable for junction electrodes and studied the relationship between their film quality and sputtering parameters. They observed that the Nb film characteristics were determined solely by the cathode voltage during sputtering regardless of the other parameters. Thus, high-quality Nb films usable for junction electrodes can be obtained by controlling the cathode voltage. The base pressure before sputtering moderately affects film quality. The authors discuss the changes in film characteristics during Josephson integrated circuit processing.

I.E.

A92-31789

SUPERCONDUCTIVE GIGAHERTZ POWER SUPPLY FOR JOSEPHSON MULTICHIP SYSTEMS

TAKASHI INOUE, SHUICHI TAHARA, SHUICHI NAGASAWA, HISANAO TSUGE, and ICHIROH ISHIDA (NEC Corp., Fundamental Research Laboratories, Ibaraki, Japan) IEEE Transactions on Applied Superconductivity (ISSN 1051-8223), vol. 2, March 1992, p. 15-20. refs

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To confirm a gigahertz frequency power supply in a multichip system, three-stage superconductive filter-type powering device (SFPD) chips and a resistive load chip for a 500 gate Josephson device were designed and fabricated. Low-loss capacitors required for this gigahertz operation were also developed. The authors tested the operation of the three-stage SFPDs in a multichip configuration

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with resistive load. A superconductive power supply with frequencies as high as 2.0 GHz was demonstrated in a multichip system for the first time. For a 2.0-GHz SFPD, normal operation was confirmed with a resonant frequency of 2.1 GHz, a resonant level of -31 dB, and a current gain of 22.4. The 0.1-Ohm input impedance of the device system was successfully transformed to 49.9 Ohms. I.E.

A92-31815

MICROSTRIP LINE FILTERS USING YTTRIUM IRON GARNET FILM

MAKOTO TSUTSUMI and SATOSHI TAMURA (Kyoto Institute of Technology, Japan) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 40, Feb. 1992, p. 400-402. refs

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The yttrium iron garnet (YIG) film microstrip line was fabricated by using 40-micron-thick film with a width of 20 mm and a length of 10 mm along with a 0.7-mm-wide microstrip and was magnetized in a transverse direction to the wave propagation. Sharp notch characteristics of more than 30 dB with few dB insertion loss were observed experimentally with a variable center frequency from 9 GHz to 11 GHz. Results are explained phenomenologically with the coupled mode theory. I.E.

A92-32428

A NEW OPTICAL NEURON DEVICE FOR ALL-OPTICAL NEURAL NETWORKS

KOJI AKIYAMA, AKIO TAKIMOTO, MICHIO MIYAUCHI, YASUNORI KURATOMI, JUNKO ASAYAMA, and HISAHITO OGAWA (Matsushita Electric Industrial Co., Ltd., Central Research Laboratories, Moriguchi, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3887-3892. refs

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A new optical neuron device has been developed. The device can perform both summation and thresholding operations in optics, and consists of a PIN a Si:H photoreceptor, aluminum neuron electrodes and a ferroelectric liquid crystal light modulator. The a-Si:H photoreceptor shows characteristics of an ideal quantum efficiency and a good linearity. The optical neuron device exhibits a response time of about 30 microns for incident light power of 9 microW and a contrast ratio of 300:1. Using this neuron device, a lenslet array and a memory mask, an all-optical neural network has been constructed. The network demonstrates an associate memory function on purely optical parallel processing without any help from electric computation. Author

A92-32430

MICROWAVE HETERODYNE MIXING BY STEP-EDGE MICROBRIDGE JOSEPHSON JUNCTIONS USING YBACUO THIN FILMS

YOSHITO FUKUMOTO, HIROSHI KAJIKAWA, RIKUO OGAWA, and YOSHIO KAWATE (Kobe Steel, Ltd., Superconducting and Cryogenic Technology Center, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3907-3910. refs

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Current-voltage characteristics and microwave mixing properties of step-edge microbridge Josephson junctions (SEJJs) made of YBaCuO thin films were systematically investigated. The step-edge was formed on the surface of a MgO(100) substrate employing the common photolithograph and wet-etching techniques. YBaCuO thin film was deposited by the off-axis sputtering method, and the microbridge junctions were fabricated so as to cross the step-edge. The SEJJs showed typical dc and ac characteristics which were explained by the resistively shunted junction model. Mixing experiments were carried out in the K-band microwave region. An

intermediate frequency output with the frequency range of about 20 MHz-2.0 GHz was successfully obtained. Author

A92-32431

EXPERIMENTAL AND SIMULATION STUDY OF AN AUXILIARY CIRCUIT TO IMPROVE GAIN OF THE QUANTUM FLUX PARAMETRON

WILLY HIOE, MUTSUMI HOSOYA, EIICHI GOTO, REIJI SUDA (Research Development Corporation of Japan, Kokubunji), and NOBUO MIYAMOTO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3920-3924. Research supported by Research Development Corporation of Japan. refs

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The gain of parametron-type devices like the Quantum Flux Parametron (QFP) is reduced by nonuniformity which causes an apparent input bias. A method to improve gain by circuit design is considered. A booster, a dc-activated QFP attached to the output of a clock-activated QFP, improves gain by doubling total output current without significantly increasing minimum input current. The booster's operation is analyzed theoretically from its quasi-static behavior and compared to results obtained from low-speed experiments on fabricated test circuits and computer simulations at high-clock rates. Author

A92-32432

FABRICATION AND NOISE PROPERTIES OF NBN NANOBRIDGE DC SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES (SQUIDS)

AKINOBU IRIE, HIROYA ABE, MICHAEL HATLE, and KATSUYOSHI HAMASAKI (Nagaoka University of Technology, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3925-3928. Research supported by SECOM Foundation. refs

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Two types of NbN nanobridge dc superconducting quantum interference devices (SQUIDS) have been fabricated. From the analyses of the response to magnetic field, it is found that the current-phase relationship for the planar-type nanobridge and the nanobridge fabricated by field evaporation is close to sinusoidal. For approximately greater than 720 microV, the spectral densities of the voltage noise show linear dependence on the voltage for the SQUIDS with nanobridges whose length is about the superconducting coherence length of NbN. The SQUIDS with nanobridges with lengths of several times the NbN coherence length exhibit parabolic voltage dependence. Author

A92-32433

A QUANTUM FLUX PARAMETRON (QFP) 12-BIT SHIFT REGISTER CAPABLE OF STABLE MICROWAVE FREQUENCY OPERATION

JUAN CASAS, RYOTARO KAMIKAWA, NOBUO MIYAMOTO, and EIICHI GOTO (Research Development Corporation of Japan, Kokubunji) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3938-3942. refs

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A 12-bit shift register employing the quantum flux parametron (QFP) as its basic element is presented. The 12-bit shift register operates at frequencies from dc up to 4.24 GHz with an on-chip total power consumption below 10 nW. Such a low power consumption is possible to obtain because the QFP has very little power dissipation and the clock lines do not dissipate power. The clock current is applied as a standing wave and is distributed by inductive division. The output waveform has been sampled in the time domain at a clock frequency of 2.4 GHz in spite of the low output signal amplitude (about 10 microV) and of the large crosstalk

with the clock frequency. The 12-bit shift register is capable of stable operation, demonstrating that at least 10×15 error-free operations per QFP are possible. Author

A92-32958

ELECTRO-OPTIC POLYMER WAVEGUIDE FABRICATED USING ELECTRIC-FIELD-ASSISTED CHEMICAL VAPOR DEPOSITION

SATOSHI TATSUURA, WATARU SOTOYAMA, and TETSUZO YOSHIMURA (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, April 6, 1992, p. 1661-1663. refs

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The paper describes the fabrication of an electrooptic (EO) polymer channel waveguide using a new technique, electric-field-assisted chemical vapor deposition. A polymer film is deposited from epoxy and nonlinear optical (NLO) aliphatic amine, using chemical vapor deposition under an electric field applied by slit electrodes on a thermally oxidized Si wafer at room temperature. A clear propagating He-Ne laser beam is observed along the electrode gap. The propagated beam's near field pattern is bright for the TE mode, but very weak for the TM mode. This indicates the NLO side groups' in-plane alignment and the fabrication of a channel waveguide. The EO coefficient of this waveguide, measured in a Mach-Zehnder interferometer, is $r(11)$ of about 0.1 pm/V. The polymer channel waveguide, which is poled at room temperature after film deposition, shows no EO response. This means NLO molecules are actually aligned during polymerizing, not after. Author

A92-32974

JOSEPHSON CHARACTERISTICS IN A-AXIS ORIENTED YBa₂Cu₃O_{7- δ} / PrBa₂Cu₃O_{7- δ} / YBa₂Cu₃O_{7- δ} JUNCTIONS

TATSUNORI HASHIMOTO, MASAYUKI SAGOI, YOSHIHISA MIZUTANI, JIRO YOSHIDA, and KOICHI MIZUSHIMA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, April 6, 1992, p. 1756-1758. Research supported by New Energy and Industrial Technology Development Organization. refs

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A sandwich-type all-oxide Josephson junction consisting of an a-axis-oriented YBa₂Cu₃O_{7- δ} / PrBa₂Cu₃O_{7- δ} / YBa₂Cu₃O_{7- δ} structure has been realized, and its Josephson characteristics were experimentally investigated. Almost all the fabricated junctions showed the Josephson characteristics, including a resistively shunted junction-like current-voltage characteristic and a Fraunhofer-like magnetic-field dependence of the critical current. The obtained maximum values of the critical-current density $j(c)$ and the $I(c)R(n)$ value were 110 A/sq cm and 80 microV, respectively, for a 50-nm-thick PBCO interlayer at 3 K. Besides, the temperature dependencies of the critical current and the normal resistance were measured. $I(c)$ was proportional to $\exp(-a \sqrt{t})$, where a is a constant. Author

A92-33145

SINGLE-MODE OPERATION OF A SUBMILLIMETER WAVE GYROTRON AT THE THIRD-HARMONIC RESONANCE

T. IDEHARA, T. TATSUKAWA, I. OGAWA, S. WADA, K. YOSHIZUE, F. INOUE (Fukui University, Japan), and G. F. BRAND (Sydney, University, Australia) Physics of Fluids B (ISSN 0899-8221), vol. 4, April 1992, p. 769, 770. Research supported by MOESC and Murata Scientific Foundation. refs

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If gyrotrons are to attain higher frequencies, high harmonic operation is necessary. In this letter, the single-mode operation of a submillimeter wave gyrotron at the third harmonic of the electron cyclotron frequency is reported. Author

A92-33517

DESIGN AND PERFORMANCE OF A PROGRAMMABLE SPATIAL CCD FILTER

TAKAO ANDO and KAZUJI WADA (Shizuoka University,

Hamamatsu, Japan) Applied Optics (ISSN 0003-6935), vol. 31, April 10, 1992, p. 1762-1768. refs

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Parallel signal preprocessing techniques in an image plane, as suggested by the mechanism of human vision, are used to improve the performance of a solid-state imaging sensor. In this paper, a 3×3 neighborhood operator, by which the gray level of a particular pixel in a transformed image can be determined from the gray levels of the corresponding pixel and its neighborhood in the original image by using appropriate algorithms, is discussed. Dynamic trade-off of signal-to-noise ratio for resolution depending on the light level is realized by combining a newly designed CCD spatial filter with variable weighting circuitry. Improvement in sensitivity by as much as 11 dB at low light levels and edge enhancement at high light levels is obtained only by varying the weighting circuit gain. The design concepts and circuit layouts are also shown together with the performance data on test imagery. Author

A92-33814

SI-IMPLANTED INGaP/GaAs METAL-SEMICONDUCTOR FIELD-EFFECT TRANSISTORS

FUMIAKI HYUGA, TATSUO AOKI, SUEHIRO SUGITANI, KAZUYOSHI ASAI (NTT, LSI Laboratories, Atsugi, Japan), and YOSHIHIRO IMAMURA (NTT, Opto-Electronics Laboratories, Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, April 20, 1992, p. 1963-1965. refs

Copyright

A new device structure for Si-implanted GaAs MESFETs with an InGaP thin film on the GaAs surface is proposed. A 200 Å InGaP film passivated the GaAs surface and increased the Schottky barrier height on n-type GaAs layers with a carrier concentration as high as 3×10^{18} /cm³ to more than 0.6 eV. These effects persisted after annealing at 800 °C for 10 min. The transconductance of 2-micron-gate MESFETs remained above 150 mS/mm at gate voltages up to 1.0 V. Si-implanted InGaP/GaAs MESFETs are thus promising devices for use in high-speed and low-noise integrated circuits. Author

A92-34846

NOVEL OPTOELECTRONIC RS FLIPFLOP BASED ON OPTICALLY COUPLED INVERTERS

T. CHINO, K. MATSUDA, H. ADACHI, and J. SHIBATA (Matsushita Electric Industrial Co., Ltd., Moriguchi, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 7, March 26, 1992, p. 641, 642. refs

Copyright

An optoelectronic RS flipflop emitting differential output has been proposed and demonstrated. It consists of two optical inverters. Optical interconnections are used to couple these inverters. Stable operation for the variation of bias voltage is demonstrated, which exhibits the possibility for 2-dimensional integration. Author

A92-35892

FABRICATION OF A Bi-2212/Ag PANCAKE COIL GENERATING 6000 G AT 4.2 K IN 12 T

JUN-ICHI SHIMOYAMA, TAKESHI MORIMOTO (Asahi Glass Co., Ltd., Research Center, Yokohama, Japan), HITOSHI KITAGUCHI, HIROAKI KUMAKURA, KAZUMASA TOGANO, HIROSHI MAEDA (National Research Institute for Metals, Tsukuba, Japan), KATSUMI NOMURA, and MASAHIRO SEIDO (Hitachi Cable, Ltd., Advanced Research Center, Tsuchiura, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L163-L165. refs

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A Bi₂Sr₂CaCu₂O_y (Bi-2212)/Ag single pancake coil with dimensions of 45 mm phi (outer)/13 mm phi (inner) x 20 mm was fabricated by the wind, react and wind method. The critical current of the coil was 230 A at 4.2 K in 12 T assuming the criterion as 10×10^{-13} ohm m. At this moment, a generated field of 6000 G was detected at the center position of the coil by the Hall probe measurement. Author

A92-35896

34 GHZ BANDWIDTH GAAS HIGH-SPEED SCHOTTKY BARRIER PHOTODIODE FABRICATED BY CHEMICAL-BEAM EPITAXY

YOUICHI SEKIGUCHI, TOHRU KUWAHARA, FUMIHIKO KOBAYASHI, and SHINJI IIO (Optical Measurement Technology Development Co., Ltd., Musashino, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L180-L182. refs

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A high-speed, high-sensitivity GaAs Schottky barrier photodiode grown by chemical-beam epitaxy (CBE) has been designed, fabricated, and characterized. Antireflection coatings utilizing Si and SiO₂ films were optimally used to minimize reflection loss, thereby significantly improving sensitivity of the Schottky barrier photodiode. This device has a -3 dB cutoff frequency of 34 GHz, determined by an optical heterodyne technique, an external quantum efficiency of 41 percent at 780 nm wavelength, and a dark current of 100 pA (VR = -2 V). Author

A92-35897

PHOTONIC INTEGRATED CIRCUIT COMBINING TWO GAAS DISTRIBUTED BRAGG REFLECTOR LASER DIODES FOR GENERATION OF THE BEAT SIGNAL

MINORU MAEDA, TAKAAKI HIRATA, MASAYUKI SUEHIRO, MAMORU HIHARA, AKIRA YAMAGUCHI, and HARUO HOSOMATSU (Optical Measurement Technology Development Co., Ltd., Musashino, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L183-L185. refs

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A92-37003

MODULATION OF PHOTOLUMINESCENT INTENSITY BY APPLYING HIGH ELECTRIC FIELD IN DOUBLY INSULATED CAS:EU PHOSPHOR THIN FILMS

M. ANDO (Hitachi, Ltd., Hitachi Research Laboratory, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 18, May 4, 1992, p. 2189-2191. refs

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Emission modulation effect produced by applying electric fields in a CaS:Eu phosphor thin film was studied. The CaS:Eu polycrystalline thin film was sandwiched between the insulating layers so that high electric fields up to 10 exp 6 V/cm could be applied to the film. As a result, the photoluminescent intensity decreased with increasing applied electric field and the maximum modulation degree of 97 percent was obtained. The photoluminescent modulation effect was found to be caused by field-induced ionization (a kind of tunneling effect) of the excited state of Eu(2+) localized-luminescent centers. These results indicated that the photoluminescent intensity of the phosphor thin films can be modulated by the electric field as well as by excitation intensity. These new features should offer the phosphor thin films new applications such as a spatial light modulator. Author

A92-38831

A 622 MB/S MONOLITHICALLY INTEGRATED INGAAS/INP FOUR-CHANNEL P-I-N FET RECEIVER ARRAY

Y. AKAHORI, M. IKEDA, N. UCHIDA, J. YOSHIDA (NTT, Opto-Electronics Laboratories, Kanagawa, Japan), and Y. SUZUKI (NTT, Transmission Systems Laboratories, Kanagawa, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 4, no. 5, May 1992, p. 470-472. refs

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The authors describe the sensitivity and crosstalk characteristics of a long-wavelength monolithically integrated four-channel photoreceiver array. This receiver consists of 4 p-i-n PDs, 24 JFETs, and 28 level-shift diodes. The device is fabricated using MOVPE-grown crystals and a Be ion implantation technique. The receiver chip demonstrates a sensitivity of between -30.6 and -31.4 dBm, and crosstalk below -20 dB over its operating frequency range. Sensitivity deterioration due to crosstalk is demonstrated

and is shown to be a critical factor in system performance. The crosstalk is mainly due to parasitic inductances on the external power supply circuits. I.E.

A92-38834

DYNAMIC SET AND RESET OPERATIONS WITH A SINGLE OPTICAL BEAM FOR AN INGAASP/INP OPTOELECTRONIC LATCHING DEVICE

KENICHI MATSUDA and JUN SHIBATA (Matsushita Electric Industrial Co., Ltd., Semiconductor Research Center, Osaka, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 4, no. 5, May 1992, p. 483-485. refs

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A novel optoelectronic latching device is proposed and demonstrated. The device has a stacked structure consisting of a light-emitting diode (LED) and two heterojunction phototransistors (HPTs). The LED and one of the HPTs are connected electrically in series to form a bistable switch based on optical positive feedback. The other HPT is connected in parallel to the switch for reset operation. A single optical beam modulated with pulse signals is input to both HPTs simultaneously. The optical pulse with a peak power ranging from 7 to 30 micro-W turns on the switch, and the pulse with higher optical power turns it off. I.E.

A92-38955

OPTOELECTRONIC ADAPTIVE NEURO-DEVICE

H. YONEZU, K. KANAMORI, K. TSUJI (Toyohashi University of Technology, Japan), T. HIMENO (Toshiba Corp., Semiconductor Technology Laboratories, Kawasaki, Japan), Y. TAKANO (Shizuoka University, Hamamatsu, Japan), and K. PAK (Toyohashi University of Technology, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 8, April 9, 1992, p. 715-717. Research supported by MOESC and Research Foundation for the Electrotechnology of Chubu. refs

Copyright

The development of a new adaptive neurodevice with a nonvolatile memory function is reported. The adaptive neurodevice is based on EEPROM technology and has additional control electrodes; the synaptic weights are varied during operation depending on target signals. The device can be used for implementing learning algorithms for self-organizing neural networks. It can also be used in hardware implementing learning algorithms without a teacher or in other adaptive circuits where the desired output varies according to reference signals. V.L.

A92-40254

SYMMETRIC P-N-P INALAS/INGAAS DOUBLE-HETEROJUNCTION BIPOLAR TRANSISTORS FABRICATED WITH SI-ION IMPLANTATION

ATSUSHI NAKAGAWA and KAORU INOUE (Matsushita Electric Industrial Co., Ltd., Semiconductor Research Center, Moriguchi, Japan) IEEE Electron Device Letters (ISSN 0741-3106), vol. 13, no. 5, May 1992, p. 285-287. refs

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Symmetric P-n-P InAlAs/InGaAs double-heterojunction bipolar transistors (DHBTs) were successfully fabricated using self-aligned Si-ion implantation and refractory emitter contacts with current gains of 115 and 30 in the emitter-up and the emitter-down configurations, respectively. Two thin Be-doped In(0.53)Ga(0.47)As layers inserted on both sides of base lead to the excellent I-V characteristics. It was shown that hole injection from the external portions of the emitter is expected to be suppressed by a factor of 10 exp -5 to 10 exp -3 at a collector current density of about 10 exp -3 A/sq cm, which is much smaller than that of N-p-n GaAs/AlGaAs HBTs, and that the DHBTs are promising devices for application to circuits with low power dissipation. Author

A92-40283

CHARACTERIZATION OF PICOSECOND PULSE PROPAGATION IN A MICROSTRIP LINE DIVIDER

YONGXI QIAN, LEI ZHU, and EIKICHI YAMASHITA (University of Electro-Communications, Chofu, Japan) IEEE Microwave and

Guided Wave Letters (ISSN 1051-8207), vol. 2, no. 5, May 1992, p. 191-193. refs
Copyright

Theoretical and experimental results are presented for the transmission properties of picosec pulses through a microstrip line divider. Computer simulations of pulse propagation through a 3-dB microstrip line divider having a curved-line branching pattern are obtained by incorporating full-wave analysis results in the frequency domain into a Fourier transform algorithm. Excellent agreement is obtained between theoretical predictions and experimental results. O.C.

A92-40330 TRANSIENT ANALYSIS OF STORED CHARGE IN NEUTRAL BASE REGION

KUNIHIO SUZUKI, SHIGEO SATOH, and NORIAKI NAKAYAMA (Fujitsu Laboratories, Ltd., Atsugi, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, no. 5, May 1992, p. 1164-1169. refs

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The transient relationship between stored charge in the neutral base region and electron current at emitter-base and base-collector junctions is studied. It is shown that the Gummel-Poon model (1969) predicts that the entire charge is partitioned to the emitter terminal. The partitioned-charge model predicts that two-thirds of the stored charge is partitioned to the emitter terminal and the remainder to the collector terminal. Transient analysis supports the partitioned-charge model when the emitter-base junction voltage decreases from the switch-on voltage to zero and time is longer than the ratio of the square of the base-collector current to the product of pi-squared and the minority electron diffusion coefficient. However, transient analysis supports the Gummel-Poon model when junction voltage increases from zero to the switch-on voltage. Thus, an alternate model is proposed based on the sign of the time gradient of the emitter-base junction voltage. S.A.V.

**A92-40914
GROWTH OF CARBON-DOPED BASE GaAs/ALGaAs HBT BY
GAS-SOURCE MBE USING TEG, TEA, TMG, ASH3, AND Si2H6**
HIDEYASU ANDO, TOSHIO FUJII, ADARSH SANDHU, TSUYOSHI TAKAHASHI, HIDEAKI ISHIKAWA, NAOYA OKAMOTO, and NAOKI YOKOYAMA (Fujitsu Laboratories, Ltd., Atsugi, Japan) (Chemical beam epitaxy and related growth techniques 1991; Proceedings of the 3rd International Conference /ICCB-3/, Oxford, England, Sept. 1-5, 1991. A92-40901 16-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 120, no. 1-4, May 1992, p. 228-233. refs

Copyright

High-performance carbon-doped-base GaAs/AlGaAs heterobipolar transistors (HBTs) were grown by gas-source MBE using only gaseous sources including dopant sources. The AlGaAs emitter layer was doped with Si from uncracked Si2H6 and the base layer was doped with carbon from TMG. From SIMS analysis it was confirmed that a well-defined emitter-base junction with sharp carbon profile was obtained. The base-current ideality factor from the Gummel plot was 1.47, and the emitter-base junction ideality factor was 1.12. A high dc current gain of 53 was obtained at a current density of 4×10^4 A/sq cm. The device characteristics of our carbon-doped HBTs were found to be stable under current stress. Author

A92-41405 TRANSISTOR ACTION OF METAL (COSI2)/INSULATOR (CAF2) HOT ELECTRON TRANSISTOR STRUCTURE

S. MURATAKE, M. WATANABE, T. SUEMASU, and M. ASADA (Tokyo Institute of Technology, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 11, May 21, 1992, p. 1002-1004. Research supported by MOESC, Research Center for Ultra-High-Speed Electronics, and Murata Science Foundation. refs

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The first transistor action of tunneling hot electron transistors with single-crystalline metal (CoSi2)/insulator (CaF2) has been achieved. This device consists of CoSi2/CaF2 heterojunctions grown on n-Si(111) substrate by ionized beam epitaxy for CaF2

and a two step growth technique for CoSi2. Transfer efficiency was more than 0.9 for hot electrons through 1.9 nm-thick CoSi2 metal base layer at 77 K. Author

A92-41593 POLYCRYSTALLINE DIAMOND HYDROGENATED AMORPHOUS SILICON P-N HETEROJUNCTION

HIDEO KIYOTA, MASAHIRO YONEDA, HIROSHI IZUMIYA, HIDEYO OKUSHI (Electrotechnical Laboratory, Tsukuba, Japan), KEN OKANO, TATEKI KUROSU, and MASAMORI IIDA (Tokai University, Hiratsuka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L388-L391. refs

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Electrical properties of a heterojunction between a p-type polycrystalline diamond and n-type hydrogenated amorphous silicon (a-Si:H) are described for the first time. The current(I)-voltage(V) characteristics of the p-n heterojunction show good rectification, and the capacitance(C)-voltage(V) characteristics show an approximate linear ($C \exp -2$)-V relationship in the reverse bias condition. These results and other experimental evidence have confirmed that the rectification is caused by the depletion layer in the vicinity of the junction. Author

A92-41599 FABRICATION OF ULTRAFINE X-RAY MASK USING PRECISE CRYSTAL GROWTH TECHNIQUE

YASUYUKI MIYAMOTO, KAZUHIITO FURUYA, and DAISUKE YAMAZAKI (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L432-L435. Research supported by MOESC. refs

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Fabrication of an ultrafine pitch mask for X-ray lithography by precise crystal growth is proposed. With the use of a precise crystal growth technique, a grating pattern with nanometer pitch and/or a precision of the atomic spacing can be transferred. As a preliminary experiment, masks of GaInAs/InP layered structure were grown by organometallic vapor phase epitaxy (OMVPE) and patterns were transferred by Cu-L X-ray. One-hundred-nm patterns were transferred onto resist layers. Author

A92-42127 PROPOSAL FOR SURFACE TUNNEL TRANSISTORS

TOSHIO BABA (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L455-L457. refs

Copyright

A new three-terminal tunnel device, the surface tunnel transistor (STT), is proposed, and its operation is demonstrated using GaAs/AlGaAs. STT consists of $n(+)/i/p(+)$ diode structure with an insulated gate in the i-region, which is similar to a MOSFET. However, the source and drain are oppositely doped. The most important feature of this device is that the drain must be so highly degenerated that a tunnel junction is formed with a 2D electron channel under the gate. The tunneling current from source to drain is controlled by the gate bias through the concentration of accumulated 2D electrons under the gate. GaAs STTs with $i\text{-Al}(0.6)\text{Ga}(0.4)\text{As}$ as a gate insulator are fabricated using MBE regrowth techniques on a mesa structure. This device exhibits transistor characteristics at 77 K and at room temperature, which confirms the new operation principle of STTs. Author

A92-42129 MAGNETIC SHIELDING PROPERTY OF BI(PB)-SR-CA-CU-O SUPERCONDUCTING TUBE

KEIZOU TSUKAMOTO, MAMORU ISHII, HIROMASA SHIMOJIMA, CHITAKE YAMAGISHI (Nihon Cement Co., Ltd., Central Research Laboratory, Tokyo, Japan), MASASUKE TAKATA (Nagaoka University of Technology, Japan), and TSUTOMU YAMASHITA (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992,

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p. L464-L466. Research supported by Foundation for Promotion of Materials Science and Technology of Japan. refs
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The magnetic shielding property of a Bi(Pb)-Sr-Ca-Cu-O superconducting tube was examined. The measured internal magnetic flux density of the tube, as a function of the applied magnetic field, agreed with the critical state model calculated with the consideration of the hysteresis of the critical current density on the magnetic field. Author

A92-42389

FABRICATION PROCESS AND PROPERTIES OF NB-INSB-NB PLANAR JUNCTION

TSUNEHITO HATO, HIROYUKI AKAIKE, YOSHIKI TAKAI, and HISAO HAYAKAWA (Nagoya University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1039-1044. Research supported by MOESC. refs
Copyright

The paper describes a new process for the fabrication of a Nb-InSb-Nb planar junction with a normal layer of an InSb thin film, in which it is possible to avoid damage typically caused by fabrication. The process can be used for fabrication of a three-terminal devices with a gate electrode. The Nb-InSb-Nb junction fabricated by this process has a channel width of 5 microns and a channel length of less than 0.20 micron and exhibited a supercurrent, indicating the absence of a notable barrier, such as the Schottky barrier at the interface between Nb and InSb. The InSb film has a mobility of 500-700 sq cm/V per sec, which is 17-23 times larger than that of Si. I.S.

A92-42391

CHARGE STORAGE PHENOMENA AND I-V CHARACTERISTICS OBSERVED IN ULTRATHIN POLYIMIDE LANGMUIR-BLODGETT FILMS

MITSUMASA IWAMOTO and ATSUSHI FUKUDA (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1092-1096. refs

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Au/PI/Al junctions were fabricated and the charge storage phenomena in polyimide (PI) layers were examined. The current-voltage (I-V) characteristics of the junctions were examined in connection with charge storage phenomena. It was found that numerous excess charges were injected into PI multilayers from electrodes by the application of biasing voltages. Therefore, the space charge field formed in as-deposited PI layers was distorted by the excess charges injected. It was also found that asymmetric I-V characteristics observed for Au/PI/Al junctions depended on the biasing voltages, because the space charge field formed in PI layers influenced the I-V characteristics. Author

A92-42896

ELECTRICAL APPLICATIONS OF CVD DIAMOND FILMS

NAOJI FUJIMORI (Sumitomo Electric Industries, Ltd., Itami Research Laboratories, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 901-908. refs
Copyright

Electronics applications of CVD diamond films are reported. The properties of epitaxial diamond films are affected by the orientation of the substrate and the deposition conditions. Boron-doped epitaxial films are found to have the same characteristics as natural Ib diamonds. An LED and an FET were successfully fabricated using boron-doped epitaxial films and Schottky junctions. However, these devices did not exhibit satisfactory properties. Other applications of CVD diamond films include speaker diaphragms (as both a thin-film coating and a free-standing film), and as an ideal packaging material (due to its high thermal conductivity and low dielectric constant). S.A.V.

A92-42898

SYNTHESIS OF N-TYPE SEMICONDUCTIVE DIAMOND FILM AND FABRICATION OF A PN JUNCTION DIODE

KEN OKANO, HIDEO KIYOTA, TATSUYA IWASAKI, TATEKI KUROSU, MASAMORI IIDA, and TERUTARO NAKAMURA (Tokai University, Hiratsuka, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 917-922. refs

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N-type semiconductive diamond film has been synthesized by the hot filament CVD method using diphosphorus pentoxide as the doping source. The obtained film was identified as polycrystalline diamond containing few sq sup 2 components by means of several methods including Raman spectroscopy. From measurements of the Hall effect and the Seebeck effect, the obtained film was found to be an n-type semiconductor. A diamond pn junction diode has been fabricated by depositing p-type diamond layer on this n-type layer. The obtained diode shows distinct rectification characteristics at 300 K. This diode shows the rectification even at 370 K, and this result implies the possible use of diamond as a semiconductor in high temperature conditions. Author

A92-42907

CHARACTERIZATION OF BORON-DOPED DIAMOND EPITAXIAL FILMS AND APPLICATIONS FOR HIGH-VOLTAGE SCHOTTKY DIODES AND MESFET'S

HIROMU SHIOMI, YOSHIKI NISHIBAYASHI, and NAOJI FUJIMORI (Sumitomo Electric Industries, Ltd., Itami Research Laboratories, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 975-980. refs

Copyright

The crystallinity and electrical characteristics of boron-doped diamond epitaxial films grown on (100) oriented diamond by microwave plasma CVD are investigated. Hall effect measurements in the 300-773 K temperature range indicate that there exist acceptorlike centers other than boron in the film. Fermi degeneracy is found to occur in the 10 to the 20/cm-cubed boron concentration range. High-voltage Schottky diodes were fabricated on bilayers consisting of intrinsic diamond and p(+) type diamond, using Al for Schottky contacts and Ti for ohmic contacts. The current-voltage characteristics of these diodes are independent of temperature because of Fermi degeneracy in p(+) type diamond. The breakdown voltage is found to be as high as 520 V. MESFETs were fabricated on diamond epitaxial films using Al for gate contacts and Ti for source and drain contacts. The gate lengths and channel depths of these MESFETs are 20 microns and 0.9 micron, respectively. Drain currents tend to saturate at the drain voltage of -50 V, and the transconductance is 2.0 micro-S/mm. S.A.V.

A92-42908

CHARACTERISTICS OF METAL POINT CONTACTS ON DIAMOND THIN FILMS

K. MIYATA, Y. MATSUI, K. KUMAGAI, S. MIYAUCHI, K. KOBASHI, and A. NAKAUE (Kobe Steel, Ltd., Electronics Research Laboratory, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 981-986. refs

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Current-voltage (I-V) characteristics of Ti, Al, Au, Pt and W metal point contacts on B-doped diamond films, with varying amounts of B have been investigated. With the exception of Pt, these contacts exhibited good rectifying characteristics for diamond films with boron to carbon (B/C) ratios below 4 ppm in the reaction gas. For B/C ratios of 20 ppm and above, the I-V characteristics exhibited very large reverse leakage currents. In all cases the Pt appeared to form ohmic contacts to the diamond films. A dependence of rectifying characteristics on the metal used was also observed. In diamond films with B/C ratios of 20 ppm and

above, ohmic and space-charge-limited current (SCLC) components were observed, indicating that the dominant current transport mechanism may vary significantly from simple thermionic emission with increasing B/C ratio. Author

A92-43570

EFFECT OF BEAM ENERGY SPREAD ON RADIATION INTENSITY IN A HIGH POWER BACKWARD WAVE OSCILLATOR WITH FINITE LENGTH

TSUGUHIRO WATANABE (National Institute for Fusion Science, Nagoya, Japan), KAZUO OGURA, KAZUO MINAMI, and M. M. ALI (Niigata University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 4, April 1992, p. 1136-1140. refs Copyright

A92-43768

HIGH-QUALITY NB/HFO(X)-HF/NB JOSEPHSON JUNCTION

SHIN'ICHI MOROHASHI, TAKESHI IMAMURA, and SHINYA HASUO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 24, June 15, 1992, p. 3039-3041. refs Copyright

A niobium (Nb) Josephson junction with a hafnium (Hf) overlayer was fabricated. The Hf native oxide, formed by thermal oxidation, was used as the new tunneling barrier. Hf was selected as an overlayer because of its good affinity to Nb and strong oxygen affinity. The junction was fabricated the same way as Nb/AIO(x)-Al/Nb junctions. The junction showed excellent I-V characteristics. The critical current of the junction did not change with annealing up to 250 C. Author

A92-43887

IMPROVED INALAS/INGAAS HEMT CHARACTERISTICS BY INSERTING AN INAS LAYER INTO THE INGAAS CHANNEL

TATSUSHI AKAZAKI, KUNIHICO ARAI, TAKATOMO ENOKI, and YASUNOBU ISHII (NTT, LSI Laboratories, Atsugi, Japan) IEEE Electron Device Letters (ISSN 0741-3106), vol. 13, no. 6, June 1992, p. 325-327. refs Copyright

A novel InAlAs/InGaAs HEMT with a thin InAs layer inserted into the InGaAs channel is proposed, and its electron transport properties and device performances have been investigated. By optimizing the thickness and the exact point of insertion in the InAs layer, the mobility and electron velocity at 300 K have been increased by 30 and 15 percent, respectively, compared to the conventional heterostructure. In addition, a maximum intrinsic transconductance of 970 mS/mm and a maximum current gain cut off frequency of 58.1 GHz have been attained by a 0.6-micron-gate-length device. Author

A92-43900

INGAASP-INALAS SUPERLATTICE AVALANCHE PHOTODIODE

TOSHIKI KAGAWA, YUICHI KAWAMURA, and HIDETOSHI IWAMURA (NTT, Opto-Electronics Laboratories, Atsugi, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 6, June 1992, p. 1419-1423. refs Copyright

This letter reports the fabrication of an InGaAsP-InAlAs superlattice avalanche photodiode using a gas source molecular beam epitaxy. A quaternary alloy of InGaAsP was used for the well layers in order to suppress the dark current due to the tunneling effect. With this structure, the valence band discontinuity almost vanishes and a gain bandwidth of 110 GHz was obtained. Author

A92-43932

FABRICATION OF HIGH QUALITY NB/ALO(X)-AL/NB JOSEPHSON JUNCTIONS. II - DEPOSITION OF THIN AL LAYERS ON NB FILMS

TAKESHI IMAMURA and SHINYA HASUO (Fujitsu Laboratories, Ltd., Atsugi, Japan) IEEE Transactions on Applied

Superconductivity (ISSN 1051-8223), vol. 2, no. 2, June 1992, p. 84-94. refs Copyright

A92-43936

HIGH TC SUPERCONDUCTING ACTIVE ANTENNA WITH REFLECTOR

TOSHIRO OHNUMA and YUKI TANAKA (Tohoku University, Sendai, Japan) IEEE Transactions on Applied Superconductivity (ISSN 1051-8223), vol. 2, no. 2, June 1992, p. 113-115. refs Copyright

High Tc superconducting thick films of YBa₂Cu₃O(x) on MgO substrates have been used to fabricate an active antenna with a corner reflector. Useful detection of EM waves at 9.55 GHz is obtained with this antenna, which combines antenna and material properties. Fixed-polarization microwaves are radiated to the superconducting active antennas, and the detectivities and directivities are experimentally confirmed. The use of the corner reflector significantly enhances detection sensitivity and directivity. O.C.

A92-43946

A FUNCTIONAL MOS TRANSISTOR FEATURING GATE-LEVEL WEIGHTED SUM AND THRESHOLD OPERATIONS

TADASHI SHIBATA and TADAHIRO OHMI (Tohoku University, Sendai, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, no. 6, June 1992, p. 1444-1455. Research supported by MOESC. refs Copyright

A novel functional MOS transistor has been developed which calculates the weighted sum of all gate-level input signals, and controls the on and off transistor operations on the basis of the weighted-sum result. This scheme is analogous to that of biological neurons, prompting the designation 'nu-MOS'. The basic characteristics of nu-MOSFETs, as well as of simple circuit blocks, are analyzed on the basis of a simple transistor model and experiments. Such potential applications as nu-MOS inverters, neuron circuits, variable-threshold transistors and inverters, linear resistors, and source-follower circuits are explored. O.C.

A92-43947

ANALYSIS OF LOW SIGNAL LEVEL CHARACTERISTICS FOR HIGH-SENSITIVITY CCD CHARGE DETECTOR

SHINJI OHSAWA and YOSHIYUKI MATSUNAGA (Toshiba Corp., ULSI Research Center, Kawasaki, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, no. 6, June 1992, p. 1465-1468. refs Copyright

A 2D device simulator is presently used to analyze the low signal-level characteristics of a high-sensitivity floating-surface amplifier. The 5-percent charge/voltage conversion ratio variance thus obtained from 0.5 to 4000 signal electrons implies a capacity for the production of linear, under-10-signal-electron ratios for an actual amplifier. It is also possible to improve the charge/voltage conversion ratio by a factor of 2, relative to the fabricated device. O.C.

A92-45954

REDUCTION OF SHOT NOISE WITH LIGHT EMITTING DIODES

KAZURO KIKUCHI and MOTOKI KAKUI (Tokyo, University, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 7, July 1992, p. 1626-1630. refs Copyright

A mutual coupling scheme of LEDs is proposed and tested in which the quantum correlation between the two kinds of shot noise can reduce the intensity noise below the host-noise limit. It is found for the first time that the optical shot noise and the electrical shot noise in LEDs have identical fluctuations induced by spontaneous emission as far as the quantum efficiency is unity. The 0.45 dB reduction of noise below the standard shot noise limit was actually achieved by using the proposed scheme. C.D.

A92-46005

MONTE CARLO ANALYSIS OF THE SPACE-CHARGE EFFECT IN ALGAS/GAAS BALLISTIC COLLECTION TRANSISTORS (BCT'S) UNDER HIGH CURRENT INJECTION

HIROKI NAKAJIMA, MASAOKI TOMIZAWA, and TADAO ISHIBASHI (NTT, LSI Laboratories, Atsugi, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, no. 7, July 1992, p. 1558-1563. refs
Copyright

AlGaAs/GaAs Ballistic Collection Transistors (BCTs) are investigated by self-consistent Monte Carlo simulation, focusing on the space-charge effect in the collector region. In addition to the conventional BCT collector structure (i-p(+)-n(+)), modified collector structures which have n(-)-p(+)-n(+) and p(-)-p(+)-n(+) doping profiles are examined. By taking account of the fact that the collector delay time is composed of transit time and capacitance charging time, it is shown that the n(-)-p(+)-n(+) collector structure is effective for the suppression of the base-widening effect (Kirk effect) compared to the i-p(+)-n(+) or p(+)-p(+)-n(+) structure. Donors in the n(-) layer compensate for the negative space charges produced by near-ballistic electrons. For a simulated BCT with an n(-)-p(+)-n(+) collector, the smaller collector capacitance charging time leads to improvement in current-gain cutoff frequency under high current injection. Author

A92-46006

A STANDARD-TELEVISION COMPATIBLE 648 X 487 PIXEL SCHOTTKY-BARRIER INFRARED CCD IMAGE SENSOR

KAZUO KONUMA, SHIGERU TOHYAMA, AKIHITO TANABE, NOBUKAZU TERANISHI, KOUICHI MASUBUCHI (NEC Corp., Microelectronics Research Laboratories, Sagami, Japan), TORU SAITO (Nippon Avionics Co., Ltd., Systems Div., Yokohama, Japan), and TOSHIO MURAMATSU (NEC Corp., Guidance and Electro-Optics Div., Fuchu, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, no. 7, July 1992, p. 1633-1637. refs
Copyright

This paper describes the design and performance of a standard TV-compatible PtSi Schottky-barrier infrared CCD image sensor. This infrared CCD image sensor has an interline CCD structure with the largest number of pixels and the smallest pixel size, 21 x 21 μ m, of any infrared image sensors reported to date. The fill factor of this sensor is high, a full 40 percent. C.D.

A92-46008

STATIC PROPERTIES OF THE SUPERCONDUCTING FET - NUMERICAL ANALYSIS

MASAKUNI OKAMOTO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) IEEE Transactions on Electron Devices (ISSN 0018-9383), vol. 39, no. 7, July 1992, p. 1661-1668. Research supported by New Energy and Industrial Development Organization of Japan. refs
Copyright

In this report on a study of the feasibility of the superconducting FET using the high-Tc superconductors, static properties are calculated using an equivalent circuit model. All superconductors are assumed to behave like BCS superconductors. The proximity effect is introduced from the phenomenological equation. Although the Schottky barrier effect at the superconductor-semiconductor interface is taken into account, this effect is found to be negligible. For the statics, the SFET made of all-copper-oxide materials seems to give a much longer transit time than that of Nb-Si-Nb SFET due to low mobility of the normal conducting copper oxide assumed in this analysis. It is found, however, that a transit time of less than 1 ps can be attained if a material having a mobility as high as Si is used for the semiconductor layer. Author

A92-46031

MEASUREMENT METHOD OF HIGH TC SUPERCONDUCTING COPLANAR LINES

KIYOMICHI ARAKI, HIDEKI SAITO, NOBUYUKI YUASA, TO REI (Saitama University, Urawa, Japan), HIDEO ITOZAKI, and KENJIRO HIGAKI (Sumitomo Electric Industries, Ltd., Itami, Japan) IEEE

Transactions on Magnetics (ISSN 0018-9464), vol. 28, no. 3, May 1992, p. 1805-1809. refs
Copyright

Broadband measurements have been done on high Tc superconducting coplanar lines of YBa₂Cu₃O₇ on 100 line-oriented MgO substrate. From the transmission and reflection coefficients of coplanar line, characteristic impedance, attenuation constant, phase constant, group velocity, as well as London penetration depth of the film are derived, based on the circuit models. Author

A92-46041

MICROWAVE SAW BANDPASS FILTERS FOR SPACECRAFT APPLICATIONS

HIDEYUKI SHINONAGA and YASUHIKO ITO (Kokusai Denshin Denwa Co., Ltd., Research and Development Laboratories, Saitama, Japan) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 40, no. 6, June 1992, p. 1110-1116. refs
Copyright

This paper describes microwave surface acoustic wave (SAW) bandpass filters for spacecraft applications. Two SAW bandpass filters were designed and fabricated in the 1.5 GHz band using temperature-stable ST-cut quartz substrates. The SAW bandpass filters were then assembled in a SAW filter bank. One unique feature of the SAW filter bank is that a broader band is available by merely adding the outputs of SAW bandpass filters adjacent in the frequency domain. Measured electrical responses as well as results of transmission experiments show satisfactory performance. Finally, effects of the temperature and aging stability characteristics are investigated based on the measured and calculated responses. Author

A92-46053

38-GHZ-BAND HIGH-POWER MMIC AMPLIFIER MODULE FOR SATELLITES ON-BOARD USE

MASAFUMI SHIGAKI, SYOICHI KOIKE, KAZUO NOGATOMO, KAZUHIKO KOBAYASHI, HIDENORI TAKAHASHI, TETSUJI NAKATANI, NORIO TANIBE (Fujitsu, Ltd., Kawasaki, Japan), and YOSHIAKI SUZUKI (Communications Research Laboratory, Koganei, Japan) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 40, no. 6, June 1992, p. 1215-1222. refs
Copyright

This paper presents the design and development results of 38-GHz high-power MMIC amplifier modules for use in the solid state power amplifier (SSPA) to be carried aboard Engineering Test Satellite VI in 1993. This amplifier will be used in millimeter-wave intersatellite communication experiments. For the development of this amplifier, high-power, highly reliable FETs with 0.25 micron-long gates were designed. The FET large-signal impedance was accurately measured using an improved load-pull method and MMIC transformers. The measurements were used to design two types of MMICs: one composed of two FET cells with 600-micron-wide gates, and the other of four FET cells with 400-micron-wide gates. In addition, a two-stage amplifier package was developed consisting of two of these MMICs that can be used at 38 GHz. A Po (1 dB) of 25 dB and a gain of 11 dB were obtained. A 38-GHz test conducted during chip screening achieves a high production yield without circuits adjustment. Author

A92-46068

LENS-COUPLED IMAGING ARRAYS FOR THE MILLIMETER- AND SUBMILLIMETER-WAVE REGIONS

KAZUHIRO UEHARA, KAZUHIRO MIYASHITA, KEN-ICHIRO NATSUME, KOUKI HATAKEYAMA, and KOJI MIZUNO (Tohoku University, Sendai, Japan) (NASA, International Symposium on Space Terahertz Technology, 2nd, Pasadena, CA, Mar. 3, 4, 1991) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 40, no. 5, May 1992, p. 806-811. refs
Copyright

Four kinds of lens-coupled antenna imaging arrays have been developed for operation at millimeter- and submillimeter-wave

frequencies. The comparison between dipole antennas, Yagi-Uda's, trap-loaded antennas, and microstrip patches will be discussed from the viewpoint of the matching with the detectors and optical systems. The radiation patterns and input impedance of each antenna have been calculated and measured to attain the optimum matching using model experiments. The trap-loaded antenna arrays have been successfully applied to plasma diagnostics at the Tsukuba GAMMA 10 tandem mirror. Author

A92-46077

MILLIMETER AND SUBMILLIMETER WAVE QUASI-OPTICAL OSCILLATOR WITH MULTI-ELEMENTS

HIROTA KONDO, MASASHIGE HIEDA, MASATOSHI NAKAYAMA, TOSHIHIDE TANAKA, KATSUMI OSAKABE, and KOJI MIZUNO (Tohoku University, Sendai, Japan) (NASA, International Symposium on Space Terahertz Technology, 2nd, Pasadena, CA, Mar. 3, 4, 1991) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 40, no. 5, May 1992, p. 857-863. refs
Copyright

The utility of a quasi-optical resonator with multielements as a millimeter wave oscillator is demonstrated. The resonator consists of a Fabry-Perot cavity with a grooved mirror and a concave mirror. It can combine many solid-state sources at the millimeter and possibly the submillimeter wave regions. Frequency-locking and the combination of the coherent power of three Gunn diodes have been observed in the U-band. C.D.

A92-46082

MAGNETOSTATIC WAVE RESONATORS USING MICROSTRIP DISK

MAKOTO TSUTSUMI and TOSHIHITO UMEGAKI (Kyoto Institute of Technology, Japan) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 40, no. 5, May 1992, p. 933-937. Research supported by Japanese Broadcasting Foundation. refs
Copyright

A magnetostatic wave resonator using yttrium iron garnet film with a microstrip disk is proposed. Assuming a magnetic wall at the edge of the disk, a dispersion relation is derived and solved numerically to obtain the resonant frequency. Resonant mode charts are given for various parameters of resonator. The quality factor is also given as a function of the resonator dimensions. Resonant characteristics are confirmed experimentally using 40- and 13.5-micron thick YIG films with 5 mm diameter strip disk at S band. Author

A92-46117

ACTIVE MATRIX ADDRESSING OPERATION OF A DYNAMIC OPTICAL NEUROCHIP WITH MONOLITHICALLY INTEGRATED INGAAS/GAAS MSM-FET'S

Y. KOSHIBA, J. OHTA, S. TAI, T. TOYODA, and K. KYUMA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 4, no. 6, June 1992, p. 617-620. refs
Copyright

Active matrix addressing operation of a dynamic optical neurochip (DONC) is reported. This DONC is an integrated circuit of InGaAs metal-semiconductor-metal photodetectors (MSMPDs) and GaAs FETs. The DONC was designed so that the MSMPD has high sensitivity but the FET has almost no optical sensitivity at 915 nm. The In(O.1)Ga(0.9)As/GaAs superlattice structure was used in the MSMPDs to improve the sensitivity at low bias voltage. The sensitivity of MSMPD was 0.08 A/W, which was two order larger than that of the FET. As a result, the DONC was successfully operated without any critical influence on the switching characteristics of FETs. Author

A92-46148

OPTICALLY COUPLED 3D COMMON MEMORY WITH GAAS ON SI STRUCTURE

M. HIROSE, H. TAKATA, and M. KOYANAGI (Hiroshima University, Higashihiroshima, Japan) IN: Physical concepts of materials for

novel optoelectronic device applications II: Device physics and applications; Proceedings of the Meeting, Aachen, Federal Republic of Germany, Oct. 28-Nov. 2, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 316-322. refs
Copyright

An ultra fast data transfer speed is demonstrated for a novel three-dimensional (3D) Static Random Access Memory (SRAM) consisting of multilayer silicon LSI chips on which GaAs LEDs and photodetectors are monolithically integrated for vertical optical interconnections. A unique feature of this system is the capability of parallel data transfer from one memory layer to the upper and lower memory layers by the optical interconnections. The results of static and dynamic simulations of the optically coupled 3D common memory have indicated that a block of 512 bits data can be transferred through four memory layers within 16 nsec. This is an equivalent data transfer speed of 128 Gbits/sec/layer. Author

A92-46164

III-V SEMICONDUCTOR INTEGRATED OPTOELECTRONICS FOR OPTICAL COMPUTING

OSAMU WADA (Fujitsu Laboratories, Ltd., Atsugi, Japan) IN: Physical concepts of materials for novel optoelectronic device applications II: Device physics and applications; Proceedings of the Meeting, Aachen, Federal Republic of Germany, Oct. 28-Nov. 2, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 598-607. refs
Copyright

Recent advances in and prospects for III-V compound semiconductor integrated optoelectronics in its application to optical computing systems are examined. Attention is given to developments concerning OEICs, photonic ICs, and optical functional devices. It is concluded that this field, due to its robustness in applications, contributes greatly to the development of optical computing systems. B.J.

A92-46350

PHOTOELECTRIC PROPERTIES IN MICROSCOPIC P-N JUNCTIONS OF ORGANIC SEMICONDUCTORS

KAZUHIRO SAITO and MICHIO SUGI (Electrotechnical Laboratory, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 1, July 6, 1992, p. 116-118. refs
Copyright

Photodiodes containing microscopic p-n junctions of organic dyes were fabricated using the Langmuir-Blodgett technique. Their action as p-n junctions was confirmed by measurement of transient photoinduced voltage responses to impulsive laser light irradiation. The signal is characterized by a rapid rise followed by a slow decay, which are assignable to the photoinduced electron transfer from n-type dye to p-type dye and the reverse transfer through the junction, respectively. The decay process shows a long-time tail and cannot be described by a single exponential function. Author

A92-46376

FABRICATION OF GAINAS/INP QUANTUM WIRES BY ORGANOMETALLIC-VAPOR-PHASE-EPITAXIAL (OMVPE) SELECTIVE GROWTH ON GROOVED SIDE WALLS OF ULTRAFINE MULTILAYERS

KAZUHIRO KOMORI, AKIRA HAMANO, SHIGEHISA ARAI, YASUYUKI MIYAMOTO, and YASUHARU SUEMATSU (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5A, May 1, 1992, p. L535-L538. Research supported by MOESC. refs
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A92-46380

UPPER LIMITS OF ELECTRON BEAM CURRENTS FOCUSABLE WITH HIGH-TC BULK SUPERCONDUCTOR LENSES (SUPERTRONS)

HIDENORI MATSUZAWA, HIROAKI KOBAYASHI, KEN-ICHI OHNO, TAKEHIRO HOSODA, YUKIO CHINO, HITOSHI MIYAGI, and MASATOSHI ISHIZUKA (Yamanashi University, Kofu, Japan)

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Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5A, May 1, 1992, p. L550-L552. Research supported by MOESC and Iketani Science and Technology Foundation. refs

Copyright

A tapered Bi-based high-T_c bulk superconductor tube was used as a lens (Supertron) for relativistic electron beams (REBs). When REBs (340 keV, 1 kA, 10-ns pulse width) were injected into a lens with a 3-mm-diameter exit, the REBs were quenched at 440 A. These results reveal possible upper limits of the electron beam currents to be focused; the compressed self-magnetic field of the electron beams should be less than about 600 G at the inner surface of the lens exit. A model was proposed for the operation of Supertrons. Author

A92-46383

TIME-RESOLVED PULSE RESPONSE OF ELECTROLUMINESCENCE IN POLY(3-ALKYLTHIOPHENE) DIODES

YUTAKA OHMORI, CHIKAYOSHI MORISHIMA, MASAO UCHIDA, and KATSUMI YOSHINO (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5A, May 1, 1992, p. L568-L570. refs

Copyright

The fast and slow transition portions of the pulse response of electroluminescence in poly(3-alkylthiophene) diodes are investigated experimentally. Carrier mobilities of the poly(3-alkylthiophene)s are estimated from the fast part of the pulse response of the electroluminescence in the diodes. An average carrier mobility is found for the poly(3-dodecylthiophene) and given at $1.0 \times 10 \exp -5 \text{ sq cm/V(s)}$. The slowly increasing portion of the pulse response is theorized to relate to the increase in temperature in the junction caused by heating. A direct correlation is noted between increases in temperature of the poly(3-alkylthiophene) EL diode and the emission intensity of the diode. This temperature dependence is not found in inorganic III-V nor II-VI compounds semiconductor EL diodes. C.C.S.

A92-46967

HIGH-FREQUENCY PERFORMANCE FOR SUB-0.1 MICRON GATE INAS-INSERTED-CHANNEL INALAS/INGAAS HEMT

T. AKAZAKI, T. ENOKI, K. ARAI, Y. UMEDA, and Y. ISHII (NTT, LSI Laboratories, Atsugi, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 13, June 18, 1992, p. 1230, 1231. refs

Copyright

The high-frequency performance of a sub-0.1-micron gate InAlAs/InGaAs HEMT with a thin InAs layer inserted into the InGaAs channel is examined. The transconductance is 2.1 S/mm and the current-gain cutoff frequency is 264 GHz using a 0.08-micron-long gate. Author

A92-47967

SOR AND FEL AS SUPER-WIDEBAND AND HIGH-POWER SIGNAL GENERATORS IN THE REGION AT MILLIMETER WAVES UP TO X-RAY

RISAO HAYASHI, HARUNOBU MASUKO, and TOSHIAKI MATSUI (Communications Research Laboratory, Review (ISSN 0914-9279), vol. 37, no. 5, Dec. 1991, p. 551-573. In Japanese. refs

A review of electron beam oscillators for high-frequency and short-wavelength regions is presented. High frequency generating device using electron beams are described, and synchrotron orbital radiation (SOR) and FELs are shown to be very useful for high-power and broadband signal generators in the short-wavelength region. The principles are presented of SOR, FELs, and the wiggler as a source of SOR with wavelengths shorter and intensity greater than those of ordinary SORs in storage rings, and the characteristics of the electromagnetic wave radiation obtained from undulators and helical wigglers as monochromatic high-frequency sources are described. Electron beam accelerators using SOR and FELs are reviewed along with the present development status of SOR and FELs around the world. C.D.

A92-48336

CHARACTERIZATION OF ULTRAHIGH-SPEED PSEUDOMORPHIC INGAAS/ALGAAS INVERTED HIGH ELECTRON MOBILITY TRANSISTORS

HIROKI I. FUJISHIRO, HIROMI TSUJI, and SEIJI NISHI (Oki Electric Industry Co., Ltd., Semiconductor Technology Laboratory, Hachioji, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1272-1279. refs

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Ultrahigh-speed pseudomorphic InGaAs/AlGaAs I-HEMTs with the InGaAs channel are characterized. Charge control analysis indicates that superior 2D electron gas (2DEG) confinement into the InGaAs channel and higher 2DEG concentration are achieved in the I-HEMT, which lead to reduced short-channel effects and improved transconductance g(m). The 0.2 micron gate pseudomorphic I-HEMTs exhibit superior dc and RF characteristics as well as small short-channel effects. Delay time analysis shows that the excellent switching characteristics in the devices are attributable to higher v(s) and improved g(m) due to the inserted InGaAs channel. These results demonstrate the suitability of the pseudomorphic I-HEMT to ultrahigh-speed applications. C.D.

A92-48337

SELF-SCANNING LIGHT-EMITTING DEVICE (SLED) USING PNPN THYRISTOR STRUCTURE

YUKIHISA KUSUDA, KIYOSI TONE, SHUHEI TANAKA, and KEN YAMASHITA (Nippon Sheet Glass Co., Ltd., Tsukuba Research Laboratory, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1280-1286. refs

Copyright

A new functional optoelectronic device, the 'self-scanning light-emitting device (SLED)' is proposed and demonstrated. The SLED consists of light-emitting thyristors whose turn-on voltages interact with each other through the resistor network. The SLED acts as an optical shift register, and the light-emitting element is automatically transferred by input clock pulses. GaAs SLED operation is successfully demonstrated using three-phase transfer clock pulses, and 3 MHz is obtained as the maximum transfer rate. The diode-coupled SLED, where the turn-on voltages of the thyristors interact through the pn diode in order to obtain the transfer operation driven by a two-phase clock pulse, is proposed. The SLED has several unique functions and will become a new key device in the optoelectronic field and in optical information processing. Author

A92-48346

ELECTRO-OPTIC FUNCTIONAL WAVEGUIDE USING NEW POLYMER P-NAN-PVA FOR INTEGRATED PHOTONIC DEVICES

SHOGO URA, RYUJI OHYAMA, TOSHIAKI SUHARA, and HIROSHI NISHIHARA (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1378-1381. refs

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A thin film waveguide consisting of newly-developed polymer p-NAN-PVA was fabricated and characterized. The thin film was formed by spin-coating and poled by applying an electric field. The electrooptic (EO) coefficient r₃₃ was measured to be 14 pm/V, which is as large as half of the r₃₃ of LiNbO₃. As an application of this waveguide, a waveguide EO grating switch was proposed and demonstrated. The switching operation was confirmed preliminarily. Author

A92-49602

OPTICAL SURFACE MOUNT TECHNOLOGY

TEIJI UCHIDA, YOSHINORI MASUDA (Tokai University, Tokyo, Japan), and MASARU AKAZAWA (Japan Aviation Electronics Industry, Ltd., Central Research Laboratory, Akishima) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1652-1655. refs

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Attention is given to optical surface mount technology (SMT),

which is proposed on the analogy of the surface mount technology widely employed in current electronics, in order to tackle growing serious problems in manufacturing processes for practical optoelectronic systems. The basic structure of optical SMT, which consists of optoelectronic surface mount devices (SMDs) of the package type, an optoelectronic printed wiring board, and conventional electronic SMDs, is illustrated. Preliminary data suggest that optical SMT has great potential for future use in optoelectronics. P.D.

A92-49762**A FORMULATION FOR SURFACE IMPEDANCE BOUNDARY CONDITIONS USING THE FINITE-DIFFERENCE TIME-DOMAIN METHOD**

TATSUYA KASHIWA, OSAMU CHIBA, and ICHIRO FUKAI (Hokkaido University, Sapporo, Japan) Microwave and Optical Technology Letters (ISSN 0895-2477), vol. 5, no. 10, Sept. 1992, p. 486-490. refs

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A novel formulation for surface impedance boundary conditions using the FDTD method is presented. The impedance condition treated is limited to cases that are expressed by an equivalent circuit. The validity of the formulation is examined. A 1D case is described for simplicity, although formulations in multidimensions can be carried out in a similar manner. L.M.

A92-50422**HIGH CRITICAL CURRENT DENSITIES REPRODUCIBLY OBSERVED FOR HOT-ISOSTATIC-PRESSED PbMo6S8 WIRES WITH MO BARRIERS**

H. YAMASAKI, M. UMEDA, and S. KOSAKA (Electrotechnical Laboratory, Tsukuba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 3, Aug. 1, 1992, p. 1180-1182. refs

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Fabrication process, critical current densities (J_c), and microstructure of the superconducting PbMo6S8 wires with Mo barriers have been investigated. Reducing the volume fraction of the Mo barrier and using electron-beam-melted Mo with less deformation resistance than that of conventional powder-metallurgy-processed Mo, facilitate the densification of PbMo6S8 and J_c improvement by the hot-isostatic-pressing (HIP) treatments. It was possible to obtain reproducibly HIP-treated PbMo6S8 wires with homogeneously high J_c not less than $10 \text{ exp } 8 \text{ A/sq m}$ at 22 T and 4.2 K, which is promising for the production of future high field (greater than 20 T) superconducting magnets. Author

A92-50914**DARK AND PHOTOCONDUCTIVITY BEHAVIOR OF C60 THIN FILMS SANDWICHED WITH METAL ELECTRODES**

HISATOMO YONEHARA and CHYONGJIN PAC (Kawamura Institute of Chemical Research, Sakura, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 5, Aug. 3, 1992, p. 575, 576. refs

Copyright

It is shown that Al/C60/metal sandwich cells show remarkable rectifying effects in the dark and extremely large photoconduction after storage of Al/C60 film under air. The action spectra are very similar to the optical absorption spectrum of the film. The relationship between photocurrent and incident light intensity suggests that the former is generated by the interaction of excitons with impurity sites at the surface and near-surface of C60 at incident light intensity $P(\text{in})$ less than $3 \times 10 \text{ exp } -7 \text{ W/sq cm}$ while bimolecular recombination controls the photocarrier generation at high $P(\text{in})$. C.D.

A92-50992**ROOM TEMPERATURE NEGATIVE DIFFERENTIAL RESISTANCE OF METAL (CoSi2)/INSULATOR (CaF2) RESONANT TUNNELING DIODE**

T. SUEMASU, M. WATANABE, M. ASADA, and N. SUZUKI (Tokyo Institute of Technology, Japan) Electronics Letters (ISSN

0013-5194), vol. 28, no. 15, July 16, 1992, p. 1432-1434. Research supported by MOESC and Murata Science Foundation. refs

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The first room temperature negative differential resistance in a nanometer-thick metal (CoSi2)/insulator (CaF2) resonant tunneling diode is reported. This device consists of heterostructures with two metallic (CoSi2) wells and three insulator (CaF2) barriers grown on n-Si(111) substrate. Peak-to-valley current ratios as high as 2 at 300 K and 25 at 77 K were obtained. Author

A92-50996**ANALYSIS OF SLOT COUPLED, CIRCULAR MICROSTRIP PATCH ANTENNAS**

C. BAUMER (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 15, July 16, 1992, p. 1454, 1455. refs

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An approach analogous to a full-wave moment method solution is proposed for the analysis of slot-coupled circular patch elements. The cavity model is used to describe the principal behavior of the patch element. C.D.

A92-51445**METAL-INSULATOR-SUPERCONDUCTOR FIELD-EFFECT-TRANSISTOR USING SrTiO3/YBa2Cu3O(y) HETEROEPITAXIAL FILMS**

TATSUHIKO FUJII, KEN SAKUTA, TAKAHIRO AWAJI, KEN-ICHI MATSUI, TAKASHI HIRANO, YASUYUKI OGAWA, and TAKESHI KOBAYASHI (Osaka University, Toyonaka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5B, May 15, 1992, p. L612-L615. Research supported by MOESC, Kansai Electric Power Co., Inc., Nippon Sheet Glass Co., Ltd., et al. refs

Copyright

Planar-type metal-insulator-superconductor field-effect-transistors (MISFET) were fabricated and their current modulation characteristics were investigated. The FET had a structure of Al-gate metal/(100)SrTiO3-gate insulator/(001)YBa-2Cu3O(y)-channel, where the oxide layers were grown by selective heteroepitaxy employing pulse ArF excimer laser deposition. The FET gate was 10 microns long and 100 microns wide. Apparent field-effect modulation of drain current was seen in both the normal and superconducting states. In the superconducting state, not only the critical current but also flux-flow resistance were appreciably changed according to the applied gate voltage. Author

A92-51446**VISIBLE ELECTROLUMINESCENCE FROM P-TYPE CRYSTALLINE SILICON/POROUS SILICON/N-TYPE MICROCRYSTALLINE SILICON CARBON PN JUNCTION DIODES**

TOSHIRO FUTAGI, TAKAHIRO MATSUMOTO, MASAKAZU KATSUNO, YASUMITSU OHTA, HIDENORI MIMURA, and KOICHI KITAMURA (Nippon Steel Corp., Electronics Research Laboratories, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5B, May 15, 1992, p. L616-L618. refs

Copyright

The P-type crystalline silicon/porous silicon/microcrystalline silicon carbon pn junction diodes are fabricated and demonstrated current-induced visible light emission. Two kinds of electroluminescence are observed: one was a weak white emission at a forward current of about 90 mA, and the other was a strong orange-red one at a forward current from about 200 to 619 mA. Author

A92-51449**FABRICATION AND CHARACTERISTICS OF SCHOTTKY GATED FIELD EFFECT TRANSISTORS UTILIZING POLY(1,4-NAPHTHALENE VINYLENE) AND POLY(P-PHENYLENE VINYLENE)**

YUTAKA OHMORI, KEIRO MURO (Osaka University, Suita, Japan),

33 ELECTRONICS AND ELECTRICAL ENGINEERING

MITSUYOSHI ONODA (Himeji Institute of Technology, Japan), and KATSUMI YOSHINO (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5B, May 15, 1992, p. L646-L648. refs
Copyright

Fabrication and characteristics of Schottky gated poly(1,4-naphthalene vinylene) and poly(p-phenylene vinylene) field-effect transistors (FETs) have been reported for the first time. The FET has been realized utilizing the polymer film formed on a Schottky gated electrode deposited upon a glass substrate. From FET characteristics, the carrier concentrations and carrier mobilities are evaluated for poly(1,4-naphthalene vinylene) and poly(p-phenylene vinylene). Electrical properties are discussed on the basis of the FET characteristics for the nominally undoped samples. Author

A92-51829 SITE DEPENDENCE OF SOFT ERRORS INDUCED BY SINGLE-ION HITTING IN 64 KBIT STATIC RANDOM ACCESS MEMORY (SRAM)

KATSUNORI NORITAKE, TAKASHI MATSUKAWA, MEISHOKU KOH, KEN-ICHI HARA, MAKOTO GOTO, and IWAO OHDOMARI (Waseda University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L771-L773. Research supported by MOESC and Waseda University. refs
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With the use of a single alpha particle of 3 MeV from a collimated micron-size ion beam, soft errors have been induced incidentally in 64 kbit SRAMs. Mapping of the soft error site has revealed that the drain regions of 'off'-state transistors are most susceptible to the single-ion hitting. Author

A92-51838 JOSEPHSON EFFECT IN YBA2CU3O7/AU-AG/PB JUNCTIONS JIRO YOSHIDA, TATSUNORI HASHIMOTO, SHINJI INOUE, YOSHIHISA MIZUTANI, MASAYUKI SAGOI, and KOICHI MIZUSHIMA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1771-1777. Research supported by New Energy and Industrial Technology Development Organization. refs Copyright

A comprehensive study was carried out on the Josephson effect in YBCO/Au-Ag/Pb SNS junctions prepared on YBCO thin films with various crystal orientations. Most of the fabricated junctions showed a dc Josephson current with a clear Fraunhofer pattern dependence on the applied magnetic field, which ensured the uniformity of the fabricated junction structure. Experimental results were quantitatively compared with the conventional junction theory based on the Usadel equation. The junction characteristics were confirmed to be reasonably explained by a junction model in which a thin insulating or highly resistive layer was assumed to exist at the YBCO-Au interface. Author

A92-51839 NBN/MGO/NBN JOSEPHSON JUNCTIONS FOR INTEGRATED CIRCUITS

MASAHIRO AOYAGI, HIROSHI NAKAGAWA, ITARU KUROSAWA, and SUSUMU TAKADA (Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1778-1783. refs
Copyright

Characteristics of the NbN/MgO/NbN Josephson junction for integrated circuits have been investigated. The deposition process of the MgO film for the tunnel barrier was systematically investigated to obtain the controllability of the Josephson critical current density. The reproducibility of the Josephson critical current density was improved to ± 28 percent with the critical current density of 610 A/sq cm and ± 20 percent with the critical current density of 16 kA/sq cm. The uniformity of the Josephson critical current density across a 3 cm-square area on the substrate was

improved to ± 12 percent with the critical current density of 650 A/sq cm. Author

A92-53585 PREVENTION OF HIGH VOLTAGE BREAKDOWN BY USING PARA-XYLYLENE CONFORMAL COATING FOR SCIENTIFIC SATELLITES. II

YASUHARU TSUNEOKA, TSUTOMU OHSHIMA, MASASHI HASHIMOTO, and TOMONAU HAYASHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 957-963. refs
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The study demonstrates the effectiveness of the conformal coating of poly-para-xylylene (parylene) in preventing electrical breakdown in high voltage electronics. The parylene is a dielectric material with high dielectric strength and high melting temperature, and is shown to provide a pinhole-free conformal insulation film, which is very effective in preventing high-voltage breakdown. To promote adhesion of parylene films on various substrates, a pretreatment procedure with silicone coupling agents was studied, and the procedure established was applied to 16 high-voltage power supplies on the Akebono scientific satellite. From the start of observations in orbit up to the time of writing - more than one year - no trouble caused by high voltage breakdown occurred, this proving the present coating technique's effectiveness for application to high-voltage power supplies in spacecraft. P.D.

A92-53587 A HIGH-EFFICIENCY AND LIGHT-WEIGHT TWT POWER SUPPLY FOR ETS-VI

KATSUHIKO YAMAMOTO, SATOSHI OHTSU, and TAKASHI YAMASHITA (NTT, Applied Electronics Laboratories, Musashino, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 977-982. refs
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The paper describes a high-efficiency lightweight traveling-wave tube (TWT) power supply with a switching frequency of 200 kHz, developed for the Engineering Test Satellite VI. Special attention is given to the new techniques and devices that were developed to realize this power supply. These include a new high-voltage diode, a MOSFET, a newly developed high-voltage transformer, and high-efficiency circuits. A diagram of the TWT power supply circuit configuration is presented along with the results of TWT power supply efficiency. I.S.

A92-53588 A SOLID STATE POWER AMPLIFIER DESIGN AND PERFORMANCE FOR MOBILE COMMUNICATIONS SATELLITES

KENJI SEKINE, YOSHIKAZU DOOI, and AKIO ISO (Space Communications Research Corp., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 983-988. refs
Copyright

A high-efficiency linear solid-state power amplifier (SSPA) is developed by means of the harmonics-control technique and tested in the UHF and S-band. Illustrations demonstrate the structure and operation of harmonics-controlled amplifiers (HCAs), and the load impedance of even/odd harmonics is shown to be short/open at the FET's drain terminal. The circuit diagram and power/efficiency characteristics of the UHF-band HCA are calculated. Power efficiency of 51 percent at 70 W is demonstrated for the UHF-band SSPA, whereas 42 percent at 110 W is derived for the S-band SSPA. The total signal/intermodulation distortion ratio for the S- and UHF-band SSPAs combined is more than 20 dB at 3 dB output backoff from saturation. The high-power linear SSPAs based on HCAs are theorized to be suitable for mobile-communication satellite transponders because they are

highly efficient and offer low intermodulation distortion in a package with a low total mass. C.C.S.

A92-53589

KA-BAND ON-BOARD TRAVELING-WAVE TUBES

NAGAHISA MITA and HIDEO MAKISHIMA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 989-994. refs
Copyright

Ka-band 10 W TWTs have been developed for onboard communications satellite use. Their major features are high efficiency, light weight and high reliability. A 10.5 W TWT with a 2-stage collector will be installed in the sixth Japanese Engineering Test Satellite (ETS-VI). The lifetime of this TWT is expected to be longer than 10 years, its efficiency is 33 percent, and it weighs 640 g. An advanced 11.7 W TWT with a 3-stage collector has also been developed for future communications satellites. Its efficiency is greatly increased by a newly developed collector. This TWT has an expected lifetime of more than 10 years also, an efficiency of 38 percent, and weighs 590 g. Author

A92-53590

12GHZ 400W TWT DEVELOPMENT FOR BROADCASTING SATELLITES

HITOSHI HOSHINO, HITOSHI NAKAGAWA, YOJI MORISHITA (Japan Broadcasting Corp., Science and Technical Research Laboratories, Tokyo), MASAOKI TAKAHASHI, MITSURU YOSHIDA, and TOSHIMOTO MAKINO (NEC Corp., Microwave Tube Div., Kawasaki, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 995-1001. refs
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Presented here are the design and test results of a 12GHz, 400W helix-type travelling wave tube (TWT) for broadcasting satellites. An output power of 420W, a saturated gain of 46dB and an overall efficiency of 49 percent were obtained at the frequency of 11.9 GHz. The performances were stable and almost no thermal fading of the RF output was observed. The most significant design features to obtain the high power and stable performances are to adopt the beam focusing structure of integral pole pieces and the small gamma a of 1.15. The computer simulation technique is fully utilized for the TWT design. The second harmonic output power was measured for the TWT, and it was in good agreement with calculated results. Author

A92-53684

FAST FREQUENCY HOPPING PLL SYNTHESIZER

KAZUHIKO SEKI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) and MASAHIRO UMEHIRA (NTT, Network Systems Development Center, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1669-1674. refs
Copyright

An account is given of a fast frequency-hopping phase-locked loop (PLL) synthesizer for TDMA equipment which allows changes to the carrier frequency within the guard time of burst signals. The use of phase and frequency preset (PFP) PLL circuits allows the proposed synthesizer to achieve fast, stable frequency setting in intervals shorter than the burst signal duration. Experimental results indicate that PFP PLL circuit setting time is less than 500 microsec; the spurious level of the reference signal is less than -90 dBc. O.C.

A92-53699

S-BAND LINEARIZED SOLID STATE HIGH POWER AMPLIFIER FOR ETS-VI

KOJI HORIKAWA, MASAYOSHI TANAKA, and KAZUICHI YAMAMOTO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space

Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1773-1778. refs

Copyright

A Multiport Amplifier (MPA) is under development to facilitate the efficient use of dc power in mobile communications satellites; the MPA is composed of a high power amplifier (HPA) array, a power divider, and a power combiner which keep phase and gain balances within tolerances. In order to achieve an MPA with high output power and efficiency, a novel, predistortion-type linearizer has been developed. The result is a linearized solid-state HPA which not only functions as an MPA component, but also doubles as an HPA for other transponders. O.C.

A92-54433

THICKNESS DEPENDENCE OF LEVITATION FORCES ACTING ON MAGNETS OVER A THIN SUPERCONDUCTING SHEET

ZHONG J. YANG (Tokyo, University, Japan; Oslo, University, Norway) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L938-L941. refs
Copyright

The London theory of superconductivity is used here to calculate the thickness dependence of the levitation forces acting on magnets over a thin superconducting sheet. As an example, the point dipole results are applied to the theoretical estimation of the force acting on the tip of a magnetic force microscope. C.D.

A92-54445

LOW-OPERATION-VOLTAGE COMB-SHAPED FIELD EMITTER ARRAY

JUNJI ITOH (Electrotechnical Laboratory, Tsukuba, Japan), KAZUHIKO TSUBURAYA (Futaba Corp., Chousei, Japan), SEIGO KANEMARU (Electrotechnical Laboratory, Tsukuba, Japan), TERUO WATANABE, and SHIGEO ITOH (Futaba Corp., Chousei, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L884-L886. refs
Copyright

The dependence of emission properties on the structure of comb-shaped lateral field emitter arrays (FEAs) has been investigated. The present FEA consists of an array of rectangular emitter tips with 3 microns-wide edges and a gate self-aligned to the emitter. It was found from experimental results that the ratio of pitch (p) to edge width (a) of the array had a strong influence on the emission properties, and that p/a about 3 was an optimum ratio to lower the operation voltage. Under this condition, an emission current of 1.4 microA/tip was obtained at a gate voltage of 110 V. Author

A92-54456

DETECTION OF ELECTRON TRANSFER IN MULTILAYER SYSTEMS BY A DISPLACEMENT CURRENT-MEASURING TECHNIQUE

MAKOTO ATSUZAWA, YUTAKA MAJIMA, MITSUMASA IWAMOTO, MASAOKI KAKIMOTO, and YOSHIO IMAI (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2140-2144. refs
Copyright

A displacement current-measuring technique was used for the detection of transportation of photoexcited electrons at the interface between electrodes and monolayers prepared on the electrodes. Displacement current was found to be generated by the motion of electrodes at the interface. The current-measuring technique was also used for the detection of transportation of photoexcited electrons between two adjacent single monolayers. Displacement current was found to be generated in the direction predicted by the motion of electrons. Author

A92-54709

AC JOSEPHSON EFFECT IN SUPERCONDUCTING ALL-NB THIN-FILM NANOBRIDGES UP TO 693 GHZ

YOSHINORI UZAWA (Tokyo Institute of Technology, Yokohama, Japan), ETSUO KAWATE (National Research Laboratory of

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Metrology, Tsukuba, Japan), NOBUMITSU HIROSE, ISAO MOTOHASHI (Ibaraki University, Japan), YUICHI HARADA, MATSUO SEKINE (Tokyo Institute of Technology, Yokohama, Japan), YUKINOBU MIKI, and MASAHIRO OKAJI (National Research Laboratory of Metrology, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 8, Aug. 24, 1992, p. 967-969. refs

Copyright

All-niobium thin-film nanobridges were fabricated with bridge sizes of 40-nm length, 50-nm width, and 100-nm thickness. The performance of the nanobridges is investigated by monitoring Shapiro steps induced on the current-voltage curves by an optically pumped far-IR laser. These steps are observed up to 693 GHz (433 microns). This is a twofold increase over that previously reported on thin-film nanobridges. Author

A92-54996

COMPARISON OF ELECTRONIC CHARACTERISTICS AND THERMAL RESISTANCE FOR HEMTS GROWN ON GAAS AND SI SUBSTRATES

T. AIGO, H. YASHIRO, A. JONO, A. TACHIKAWA, and A. MORITANI (Nippon Steel Corp., Electronics Research Laboratories, Kawasaki, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 18, Aug. 27, 1992, p. 1737, 1738. refs

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HEMTs have been successfully fabricated on silicon and their thermal resistance evaluated for the first time. A maximum transconductance of 330 mS/mm was obtained with 0.8 micron gate length and 105 micron width. The thermal resistance of the HEMTs on Si was 36 +/- 5 deg/W with total device thickness of 400 microns, demonstrating that the thermal resistance of GaAs/Si is about half that of GaAs/GaAs. Author

N92-10153# Sandia National Labs., Albuquerque, NM.

SINTERED COMPACTS FOR HEAT SINKS AND PROCESS FOR FABRICATING SAME Patent Application

AKIO HARA, inventor (to Sumitomo) (Sumitomo Electric Industries Ltd., Itami (Japan).) and SHUJI YATSU, inventor (to Sumitomo) (Sumitomo Electric Industries Ltd., Itami, Japan) Nov. 1990 8 p Transl. into ENGLISH of Japanese Patent Application No. 32,154, 1987

(Contract DE-AC04-76DP-00789)

(DE91-018438; ALS/TR-90-021) Avail: CASI HC A02/MF A01

The present invention relates to sintered compacts for heat sinks and to a process for their fabrication. Over the past few years, the semiconductor devices employed in high-field and high-current density applications have been adopted for practical use. Because power consumption density is especially high in the active regions of semiconductor lasers and IMPATT devices, modifications that prevent temperature rises in the devices are necessary. As a result, much attention has been devoted to materials which have a high thermal conductivity and are capable of serving as heat sinks. DOE

N92-11282# Sandia National Labs., Albuquerque, NM.

NONAQUEOUS SECONDARY BATTERIES

TAKAYUKI YAMAHIRA and MASANORI ANZAI (Sony Corp., Tokyo, Japan) 24 Apr. 1991 16 p Transl. into ENGLISH of Japanese Patent Application No. 294372, (28 Nov. 1989)

(Contract DE-AC04-76DP-00789)

(DE91-017788; ALS/TR-91-007) Avail: CASI HC A03/MF A01

The object of the present invention is to make possible the repeated use for a long period of time of nonaqueous secondary battery that contains in the battery case a negative electrode of a carbonized organic substance, a positive electrode with Li(x)MO₂ (where M is at least one of Co and Ni; x being 0.05 less than or = x less than or = 1.10) and an electrolytic solution. The method comprises at least one charging operation of the battery before the sealing of their cells to inhibit the gas generation that would occur in the finished battery in its charging and discharging. DOE

N92-13369# Central Research Inst. of Electric Power Industry, Tokyo (Japan).

MOLTEN CARBONATE FUEL CELL POWER GENERATION SYSTEM TEST FACILITY

TAKAO WATANABE, YOSHIYUKI IZAKI, TAKAO HAYASAKA, NAGAYUKI HORIUCHI, TERUO HAMAMATSU, and HIROSHI ISHIKAWA May 1989 41 p In JAPANESE; ENGLISH summary

(DE90-503440; CRIE-W-88030) Avail: CASI (US Sales Only) HC A03

CRIEPI has installed the Molten Carbonate Fuel Cell (MCFC) Power Generation System Test Facility which can be used for the tests of the MCFC subsystem. The purpose of this facility installation are as follows: (1) to clarify the large stack performance and to evaluate the large stack durability; and (2) to develop the operation technology of the MCFC which is installed within the system. The facility is divided into two sections, the single loop and the recycle loop. Before power generation tests using MCFC stacks, CRIEPI checked the performance of the facility and ensured that the two loops have the preferable performance. DOE

N92-13370# Central Research Inst. of Electric Power Industry, Tokyo (Japan).

METHOD FOR DIAGNOSING THE INSULATION

DETERIORATION IN MICA-RESIN INSULATED STATOR WINDINGS OF GENERATOR

YASUYUKI IKEDA and HIROMASA FUKAGAWA Jun. 1989 36 p In JAPANESE; ENGLISH summary

(DE90-503991; CRIE-W-88046) Avail: CASI (US Sales Only) HC A03

For the purpose of establishing a deterioration criterion required for diagnosing the insulation deterioration of synthetic resin insulated windings of generators, data concerning the correlation between the nondestructive measurements of insulation characteristics and dielectric breakdown voltages of windings in operation were examined and collected. Coil samples were removed, and accelerated deterioration tests of model coils were carried out. The results from this investigation are presented. DOE

N92-16201# Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).

DEVELOPMENT OF ACTINIDE SUPERCONDUCTORS, PART 3

MASATO KATO (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).), SHUSAKU KOHNO (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).), RYOJI ASO (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).), HIDEYUKI FUNASAKA (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).), YUKIO WADA (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).), NOBUYUKI SASAO (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan), TOSHIKI ISHIGURO (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).), and KOJI SAKURAI Aug. 1990 31 p In JAPANESE

(DE91-522025; PNC-TN-8410-90-079) Avail: CASI HC A03/MF A01

The atoms of lanthanide elements can substitute the Ln site in LnBa₂Cu₃O(7-y) (Ln: lanthanides or Y), which have T_(sub c) of 90 K. Lanthanide and uranium substituted superconductors were synthesized, and the properties of the systems and the U-substitution effects were examined. LnBa₂Cu₃O(7-y) and Ln(0.8)U(0.2)Ba₂Cu₃O(y) were synthesized through solid-phase reaction, with La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and Y as Ln. The superconductive property, structural properties, and oxygen content were examined. In all the systems except those with Ce, Pr, Tb, and Lu, superconductivity was obtained. The larger the Ln element is, the greater the lattice constant becomes, and consequently there tend to be more oxygen defects. It was reported that with the increase of oxygen defects, the critical temperature became lower. This tendency was also observed in this study. The second phase was observed in all the U-substituted systems, but in the U-substituted systems of Gd, Eu, Sm, and Nd, the second phase was decreased, and the ratio

of solid solution of U into Ln site was 3 percent. A correlation between physical properties, such as superconductivity, crystal structure, and composition, and ion radii of the Ln elements was found. DOE

N92-16209# Japan Atomic Energy Research Inst., Tokyo.
MEASUREMENT SYSTEM FOR THE MICROWAVE SURFACE RESISTANCE OF OXIDE SUPERCONDUCTORS
 RYOHJI NAGAI (Japan Atomic Energy Research Inst., Tokyo.), MANABU TAKEUCHI (Ibaraki Univ., Mito, Japan), and EISUKE MINEHARA May 1991 33 p In JAPANESE; ENGLISH summary (DE91-522266; JAERI-M-91-074) Avail: CASI HC A03/MF A01

A measurement system for the microwave surface resistance of oxide superconductors was newly made. The measurement system consists of a specially-designed cryostat, which can keep a sample at any temperature (30-300 K) by using a helium-gas closed-loop refrigerator and a temperature controller with a heater, a microwave measuring equipment (vector network analyzer, HP-8720A), and a cavity resonator of oxide superconductor. The microwave surface resistance can be evaluated by measuring a quality factor of the cavity resonator. Detailed design and characteristics of the system are described together with typical results of the measurement. DOE

N92-17087# Loyola Coll., Baltimore, MD.
X RAY LITHOGRAPHY IN JAPAN Final Report
 JAMES T. CLEMENS, ROBERT W. HILL, FRANCO CERRINA, GENE E. FULLER, and R. F. PEASE Oct. 1991 174 p (Contract N00014-90-J-1853) (AD-A243660) Avail: CASI HC A08/MF A02

Integrated circuits (semiconductors) are the key components of modern computers, communication systems, consumer electronics, and the new generations of smart machines and instruments. Japan's strong position and growing influence in the manufacture of semiconductors and systems based on them is well known and well documented. Microlithography is one the most critical elements of the semiconductor manufacturing process because it determines the minimum feature size and the functional capabilities of the semiconductor. Because it is used many times in the manufacturing sequence, the quality of the microlithography process (i.e., number of defects, control for feature size, etc.) is critical in determining the yield and cost of semiconductors and hence the competitiveness of the electronics industry. At present all volume semiconductor manufacturing is done with optical UV (ultraviolet) projection lithography, twenty-year-old photographic technology which has been and is still evolving. There are many issues that limit the technical capability and cost-effectiveness of UV lithography, and thus, alternate lithographic techniques are continuously being researched and developed. X-ray lithography, which was invented in the early 1970's, holds the promise of providing higher yields in manufacturing semiconductors by virtue of enhanced process latitude, process robustness, and resolution. Author (GRA)

N92-18491# National Inst. of Standards and Technology, Gaithersburg, MD. Magnetic Materials Group.
HIGH MAGNETIC FIELD FACILITIES IN JAPAN RELATED TO SUPERCONDUCTIVITY RESEARCH (JAPAN TECHNOLOGY PROGRAM)
 ROBERT D. SHULL Aug. 1991 62 p (PB91-240762; NISTIR-4593) Avail: CASI HC A04/MF A01

The high magnetic field facilities presently available in Japan and how those facilities are being used for the study of superconducting materials are described. Particular attention is devoted to Japanese technological advances in the development of superconducting materials which may have an impact on the construction of future high magnetic field facilities. Both pulsed magnetic field facilities and constant field generation are evaluated. In addition, future facilities to become available in Japan are listed. GRA

N92-22095# National Space Development Agency, Tokyo (Japan). Parts and Material Lab.

THE ENGINEERING SOLUTIONS TO THE PROBLEM OF SPACE RADIATION EFFECTS IN SEMICONDUCTOR DEVICES
 TATEO GOKA and SIGERU IKEDA *In its* Preprints of NASDA's 5th Technical Symposium p 159-187 1 Jun. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A03

This report presents radiation hardening techniques which have been newly developed by National Space Development Agency of Japan (NASDA) to provide engineering solutions to the problem of space radiation effects. The new developments include a program for calculating of total dose and for predicting the probability of Single Event Upset (SEU) using space radiation model, irradiation and evaluation tests, and development of radiation hardened Large Scale Integrated Circuit (LSI) devices. Also, this report presents engineering solutions which have been applied to Marine Observation Satellite-1b (MOS-1b) and the MOS-1b mission launch operations to the problem of SEU phenomena of MOS-1 satellite. Author (NASDA)

N92-22657# New Energy Development Organization, Tokyo (Japan).

STUDY FOR PROMOTION OF INTRODUCING ADVANCED BATTERY ENERGY STORAGE SYSTEMS

Mar. 1991 97 p In JAPANESE; ENGLISH summary (DE92-769389; NEDO-P-9026) Avail: CASI HC A05/MF A02

An advanced battery energy storage system is examined, with studies focused mainly on its technical development, but also its commercialization, cost, reliability, simplification and compactness. The purpose of this project is to study the parameters which are needed in order to promote introduction of the advanced battery energy storage system. Systems which are expected to be commercialized in the near future are a customer peak-cut system, an isolated island peak-cut system, and emergency electric power sources. When technology reaches maturity, a load-leveling system to be installed at substations of electric utilities are expected to be commercially used. With the study on commercial application as one of the purposes, small scale (50 to 100 kW) advanced battery energy storage systems are expected to be trially employed to peak cut use at customers (prime) end. To promote introduction of the system, it is necessary to make environmental improvement in the institutional aspect. DOE

N92-25903# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

FORMATION OF A VERY LOW-REFLECTANCE SURFACE BY ELECTROSTATIC FLOCKING

A. KATO, A. ONISHI, and T. HAYASHI *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 565-568 Dec. 1991

Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The implantation of carbon pile perpendicular to the substrate, thereby making it possible to form a surface having a very low reflectance owing to the so called light trap effect, where light beams incident of the surface are reflected and attenuated among the fibers no matter at which angle the light beam may incident, are considered. How very low reflectance flocked surfaces were achieved over a wide range of wavelengths from near ultraviolet to the infrared range by optimizing the cut length, heat treatment, and quantity of the carbon pile for lift is described. ESA

N92-27806*# Railway Technical Research Inst., Tokyo (Japan).
CHANGE IN THE COIL DISTRIBUTION OF ELECTRODYNAMIC SUSPENSION SYSTEM

HISASHI TANAKA *In* NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 2 p 813-825 May 1992

Avail: CASI HC A03/MF A04

At the Miyazaki Maglev Test Center, the initial test runs were completed using a system design that required the superconducting coils to be parallel with the ground levitation coils. Recently, the

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coil distribution was changed to a system such that the two types of coils were perpendicular to each other. Further system changes will lead to the construction of a side wall levitation system. It is hoped that the development will culminate in a system whereby a superconducting coil will maintain all the functions: levitation, propulsion, and guidance. D.R.D.

N92-70084 National Advisory Committee on Semiconductors, Washington, DC.

A STRATEGIC INDUSTRY AT RISK: A REPORT TO THE PRESIDENT AND THE CONGRESS

Nov. 1989 49 p

(PB91-165894; AD-B158189L) Avail: CASI HC A03/MF A01; 6 functional color pages

The semiconductor industry is strategic to America. The industry is the foundation of the information age, playing a crucial role in the consumer electronics sector, the computer and telecommunications industry, and other industries that have a high electronic content in their products. America's national security also depends on the semiconductor adverseries. The U.S. semiconductor industry, after an era of world leadership, is now in trouble. It has lost its dominant position in the world market. This radical change occurred in the 1980's despite the fact that American industry invented, developed, and dominated the semiconductor market for three decades. Japanese companies, encouraged by their government, have taken aggressive actions to establish a world-class semiconductor industry that now clearly leads the world market place. The U.S. semiconductor industry has been unable, for many reasons, to respond to this challenge. These reasons are examined, and the recommendations developed by the National Advisory Committee on Semiconductors to serve as initial steps toward a comprehensive national semiconductor strategy are presented. Author

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FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

A92-11701

NUMERICAL SIMULATIONS OF AXISYMMETRIC ACCRETION FLOWS

HIROSHI KOIDE, TAKUYA MATSUDA (Kyoto University, Japan), and EIJI SHIMA (Kawasaki Heavy Industries, Ltd., Aerospace Engineering Div., Kakamigahara, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 252, Oct. 15, 1991, p. 473-481. refs

(Contract MOESC-63540195; MOESC-01540221; MOESC-02234206; MOESC-03640267)

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Properties of axisymmetric accretion flow on to a gravitating compact object from a uniform flow are studied by performing pure hydrodynamic calculations. At first a comparison is made between a numerical solution and an analytic solution based on a ballistic orbit theory, and it is found that the analytic solution is an extremely good approximation even for Mach numbers as low as 1.4. Next, results are presented for Mach numbers of 0.6, 1.4, 2.4, 5, and 10, and for a ratio of specific heats of 5/3. The accretion rate, the stand-off distance of the bow shock, and the stagnation point on the rear axis are computed based on various boundary conditions. An empirical formula for the accretion rate is proposed. It is found that the flow is not completely in steady state but a dome-like shock is formed quasi-periodically in front of the compact object for higher Mach number cases. It is argued that this shock perturbs the flow, leading to the destruction of axisymmetry of the flow eventually. Author

A92-12422

ANALYSES OF HEAT ISOLATION PROPERTY FOR METALLIC MULTIWALL THERMAL PROTECTION SYSTEM

SEINOSUKE SUMI, MASAHIKO MUROZONO, KENICHI KUSHIKI, and MASAYUKI KUSAKABE Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Aug. 1991, p. 241-248. In Japanese. refs

Transient thermal analyses were carried out for a multiwall titanium thermal protection system (TPS) for the space transportation system, which consists of alternate flat and dimpled sheets which are welded together at the crests of the dimpled sheet, and formed into square tiles which are mechanically attached to the primary structure of the space transportation system. Three modes of heat transfer are considered: (1) conduction through the gas inside the tiles, (2) conduction through the metal, and (3) radiation between the adjoined sheets. Results of a steady state analysis of the three modes of heat transfer yield an effective thermal conductivity. The contributions of each mode of heat transfer to various parameters are shown. I.S.

A92-13359

OPERATING CHARACTERISTICS OF TWO-PHASE NITROGEN THERMOSYPHONS

NAOKI ICHIKAWA, MASAO SHIRAISHI (Mechanical Engineering Laboratory, Tsukuba, Japan), and MASAHIDE MURAKAMI (Tsukuba, University, Japan) IN: Advances in cryogenic engineering. Vol. 35A - Proceedings of the 1989 Cryogenic Engineering Conference, Los Angeles, CA, July 24-28, 1989. New York, Plenum Press, 1990, p. 453-460. refs

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Heat transfer characteristics of a two-phase nitrogen thermosyphon are experimentally investigated. The thermosyphon made of stainless steel has a length of 0.368 m and an inner diameter of 0.009 m. The thermal resistance of the thermosyphon is obtained as a function of heat transfer rate at various filling ratios in the vapor pressure range from 0.5×10^5 to 2.0×10^5 Pa. The effective thermal conductivity determined from the experimental results is found to be about 24 times as large as that of copper. The maximum heat transfer rate, which is 94 W, is almost the same as that of the freon thermosyphon in the moderate temperature range. Author

A92-13450

HEAT AND MASS TRANSFER WITH A BOUNDARY LAYER FLOW PAST A FLAT PLATE OF FINITE THICKNESS

SHIGERU MORI, HIROSHI NAKAGAWA, AKIRA TANIMOTO (Kanazawa University, Japan), and MIKIO SAKAKIBARA (Fukui University, Japan) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 34, Nov. 1991, p. 2899-2909. refs

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Evaporation from a flat-plate surface to a laminar boundary layer flow past the plate is theoretically analyzed, taking into account the two-dimensional thermal conduction in the plate, with the convective thermal-boundary condition on the other plate surface. The thermal effect of the volatile liquid supply to the plate is neglected. Distributions of the interfacial temperature and the local Nusselt and Sherwood numbers are calculated for a parallel flow where both Prandtl and Schmidt numbers are equal to unity. The characteristics in heat and mass transfer are revealed to be significantly influenced by the temperature dependency of the vapor-liquid equilibrium, the magnitude of the latent heat of phase change, and the thermal conductance of the flat plate. Author

A92-13459

RELATIVE DIFFUSION IN TURBULENT FLOW BY USING THE EFFECTIVE HAMILTONIAN METHOD

HAJIME NAKAO (Kwansei Gakuin University, Nishinomiya, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2942-2950. refs

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Richardson's four-thirds law is verified by applying the effective Hamiltonian method to relative diffusion in turbulent flow when

the spectrum satisfies Kolmogorov's similarity law and the scaling law. It is found that the mean square value of the relative distance of a pair of particles increases faster than the cube of the time of diffusion at the part connected with the range satisfying this law when the initial distance between them is small enough in comparison with the typical length of the flow. The method is applied to relative diffusion in the turbulent flow with multirange spectrum. O.G.

A92-13460

NON-GAUSSIAN TURBULENCE FIELD AS A DISSIPATIVE STRUCTURE

TSUTOMU SANADA (Institute of Computational Fluid Dynamics, Tokyo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2951-2959. refs

Copyright

The dynamical mechanism producing non-Gaussian (intermittent) turbulence field with a large kurtosis is investigated on the basis of theoretical considerations and from the results of full numerical simulations of three-dimensional inviscid truncated system and Navier-Stokes equation. The simulations show that the nonlinearity plus the viscous dissipation in the Navier-Stokes equation maintain the large kurtosis; the intermittency can be characterized as a dissipative structure produced by a nonequilibrium and nonlinear system. On the other hand, the phase correlation producing the large kurtosis may contribute to the energy transfer. This result indicates that the intermittency and the energy transfer have a complementary relation to each other. Author

A92-14032

INTERFACE DYNAMICS OF CAPILLARY DRIVEN FLOW IN A TUBE

NAOKI ICHIKAWA, YOKO SATODA, and TAKESHI NAKADA (Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 485-490. In Japanese. refs

This paper describes the dynamics of a liquid driven by capillary force in a tube. The movement of a gas-liquid interface in a horizontal tube as a result of capillary action has been investigated. A theoretical analysis of the interface dynamics is presented where dimensionless numbers representing time and distance scales are introduced, and a unique functional relation is derived. Experiments were carried out with distilled water as the test liquid in glass tubes of inner diameter from 0.5 mm to 4.0 mm. The position of the gas-liquid interface as a function of time was observed. The experimental results agree well with theory. Author

A92-14773

COMPUTER SIMULATION OF OSCILLATORY MARANGONI FLOW

MITSURU OHNISHI, HISAO AZUMA (National Aerospace Laboratory, Chofu, Japan), and TAKAO DOI (NASDA, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs

(IAF PAPER 91-402) Copyright

Numerical simulations of thermocapillary convection of low-Prandtl number melts in a rectangular cavity subject to a horizontal temperature gradient under zero gravity are performed. A range of the Marangoni number is from 100 to 1000 and a range of mesh size is from 25 x 100 to 50 x 200. The simulation results show that the flow pattern is strongly influenced by mesh size of the simulation, if the Marangoni number exceeds in the value of 300. When the finest mesh is used, the oscillatory Marangoni convection appears under low-Marangoni number such as 400. If the Marangoni number is higher than 700, three flow patterns appear with changing mesh size. The first is high frequency oscillation, the second is multifrequency oscillation and the last is slow frequency oscillation. Author

A92-14775

MARANGONI CONVECTION IN A LIQUID BRIDGE UNDER EARTH GRAVITY CONDITION

AKIRA HIRATA, SHIN-ICHI NISHIZAWA (Waseda University,

Tokyo, Japan), NOBUYUKI IMAISHI (Kyushu University, Kasuga, Japan), YASUNORI OKANO (Tohoku University, Sendai, Japan), M. Z. SAGHIR, and PAUL J. SCOTT (Canadian Space Agency, Ottawa, Canada) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. Research supported by Ministry of External Affairs of Canada, Japan Science and Technology Fund, and Canadian Space Agency. refs

(IAF PAPER 91-407) Copyright

Marangoni convection in a liquid bridge, which is heated from the top and cooled from the bottom during the transient heating process under normal gravity conditions was numerically studied. Several steady states were achieved during the transient process. These steady states were observed during several experiments. Calculated temperature distributions, stream lines, surface velocity at the center of the liquid bridge and the position of the vortex center, during each steady state are in good agreement with experimental observations. Author

A92-15330

A ROBUST FLOW CALCULATION TECHNIQUE WITH MULTIPLE FINITE CONTROL VOLUMES

E. MORISHITA (Tokyo, University, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 121-125.

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The control-volume method describes the forces which act on the system, but not necessarily the wall pressure of the system. An attempt is made to develop a control volume method which makes it possible to obtain the wall pressure of the control volume. The 2D inviscid incompressible steady duct flow is considered. The conservation equations in integral form are discretized for a control volume. The circulation along the control surface is expressed as a nonlinear function of the vertical velocity component at the inlet and is set equal to zero for the inviscid flow. The equation is solved by the Newton method, and the other aerodynamic properties can be obtained. The calculated results are compared to the experiment and the agreement is found to be satisfactory. Author

A92-15333

FLOW OF A VISCOUS FLUID PAST A FLEXIBLE MEMBRANE

K. YAMAMOTO, M. OKADA, and J. KAMEYAMA (Okayama University, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 150-155. refs

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The paper treats the numerical calculation of a steady 2D viscous flow past a flexible membrane. Both edges of the membrane are fixed in the flow, and its chord is set normal to the flow. The numerical calculations of the Navier-Stokes equation based on a finite-difference method and a relaxation method are carried out for several values of the membrane tension in cases when the Reynolds numbers are 5, 10 and 20. It is found that the membrane tension has a minimum value below which there is no steady shape of the membrane. Two different shapes of the membrane are possible at a given value of tension: one is of small deformation, while the other a large deformation. There appear twin vortices in the concave region of the membrane shape if its deformation increases to a certain extent. Author

A92-15358

OSCILLATION OF NEARLY CIRCULAR SHOCK WAVES

MYEONG-KWAN PARK, SHUZO OSHIMA, and RYUICHIRO YAMANE (Tokyo Institute of Technology, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 447-456. refs

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Oscillation modes of nearly circular shock waves in supersonic radial flow were investigated both theoretically and experimentally. The shock waves deformed from circular shape were obtained by the asymmetric back pressure produced by downstream obstacles. Oscillation modes of the shock waves were investigated by means of static study of the phase function and mean coherence in each static mode. The oscillation consisted of mode 0 and the

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same mode as the original static shape. The frequency of each static mode depended on the deformation from the real circle.

Author

A92-15488

GAUSSIAN AND NEAR-EXPONENTIAL PROBABILITY DISTRIBUTIONS OF TURBULENCE OBTAINED FROM A NUMERICAL SIMULATION

KIYOSHI YAMAMOTO (National Aerospace Laboratory, Chofu, Japan) and TSUTOMU KAMBE (Tokyo, University, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 8, Oct. 1991, p. 65-72. refs

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The probability distributions of the various quantities characterizing three-dimensional turbulence are investigated. The numerical simulation of the turbulence presented here has been conducted to study decaying homogeneous turbulence at moderately large Reynolds numbers by Yamamoto and Hosokawa. Various turbulent fields are constructed from the velocity Fourier modes contained in three different regions of the wavenumber space: inertial range, dissipation range and whole wavenumber space. As a result, nearly Gaussian and near-exponential distributions are obtained for the velocity, its longitudinal and lateral derivatives in the physical space and the Fourier modes in the wavenumber space. They mostly confirm the result of She et al. (1988). The near-exponential distributions are obtained not only for the velocity derivative fields, but also for the velocity field obtained from the dissipation range. It is found that the asymmetric distributions of the longitudinal derivative, which is closely related to the stretching of fluctuating vorticity in the turbulent flow, are detected for all the fields. The flatness factors of higher longitudinal derivatives of the velocity are also evaluated in addition to the skewness factor of the first longitudinal derivative.

Author

A92-15489

VORTEX INTERACTION AND KOLMOGOROV SPECTRUM

M. KIYA and H. ISHII (Hokkaido University, Sapporo, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 8, Oct. 1991, p. 73-83. refs

(Contract MOESC-01460108)

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An inviscid vortex-dynamics simulation of interaction of several circular vortex rings produced the power spectrum which had the Kolmogorov $-5/3$ power law. The enstrophy spectrum, which is equivalent to the dissipation spectrum in homogeneous turbulence, had the $1/3$ power law in the same wavenumber range. The wavenumber range of the $-5/3$ power-law spectrum slightly depends on the number of vortex rings and their initial configurations, being wider for smaller core radii of the vortex rings. The length scale of energy-containing eddies was obtained as the reciprocal of a wavenumber at which the energy spectrum attained a dominant peak, while the Kolmogorov length scale was defined as that of a wavenumber at which the enstrophy spectrum attained a dominant peak. Five invariants of inviscid vortical motion, i.e., the total energy, total momentum, total angular momentum, total helicity and total vorticity were maintained constant within tolerable deviations from the corresponding initial values until vorticity began to diverge.

Author

A92-15491

ORTHONORMAL WAVELET ANALYSIS OF TURBULENCE

MICHIO YAMADA (Kyoto University, Uji, Japan) and KOJI OHKITANI (Kyoto University, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 8, Oct. 1991, p. 101-115. refs

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The orthonormal wavelet expansion method is applied to data of atmospheric turbulence extending over more than two decades in Kolmogorov's inertial subrange. First, the orthonormal wavelet expansion is described and a numerical scheme for the expansion coefficients is proposed. Then, by the use of the orthonormal wavelets, several characteristics of turbulence are discussed in comparison with those of artificial, random noise. In particular, the

local wavelet spectra of turbulence show a similarity structure, which is absent in the artificial random noise and is identified with the trace of the energy cascade process.

Author

A92-15494

LOG-STABLE DISTRIBUTION IN TURBULENCE

S. KIDA (Kyoto University, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 8, Oct. 1991, p. 135-138. Research supported by MOESC. refs

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The log-stable distribution proposed by the author is found to be in agreement with the observed probability-density function for the logarithm of the derivative of the velocity in a turbulent boundary layer. This comparison is made after the determination of two free parameters by fitting the scaling exponent of the velocity differences measured in a different experiment.

Author

A92-15675

FILM COOLING ON A GAS TURBINE ROTOR BLADE

KENICHIRO TAKEISHI, SUNAO AOKI, TOMOHIKO SATO, and KEIZO TSUKAGOSHI (Mitsubishi Heavy Industries, Ltd., Takasago, Japan) ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991. 8 p. refs

(ASME PAPER 91-GT-279)

The film cooling effectiveness on a low-speed stationary cascade and the rotating blade has been measured by using a heat-mass transfer analogy. The film cooling effectiveness on the suction surface of the rotating blade fits well with that on the stationary blade, but a low level of effectiveness appears on the pressure surface of the rotating blade. In this paper, typical film cooling data will be presented and film cooling on a rotating blade is discussed.

Author

A92-15824

NUMERICAL SIMULATION OF THE REFLECTION OF A PLANAR SHOCK WAVE OVER A DOUBLE WEDGE

K. ITOH (National Aerospace Laboratory, Kakuda, Japan), K. TAKAYAMA (Tohoku University, Sendai, Japan), and G. BEN-DOR (Negev, University, Beersheba, Israel) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 13, Nov. 20, 1991, p. 1153-1170. refs

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A numerical code based on the upwind TVD scheme for simulating the various reflection processes of a planar shock wave over a concave or convex double wedge is developed. The numerical results are compared with actual experiments and good agreement is obtained. The excellent agreement serves also as a validation of the shock-capturing performance of the numerical scheme.

Author

A92-16464

COMPARISON OF VELOCITY DISTRIBUTION FUNCTIONS IN AN ARGON SHOCK WAVE BETWEEN EXPERIMENTS AND MONTE CARLO CALCULATIONS FOR LENNARD-JONES POTENTIAL

HIROAKI MATSUMOTO and KATSUHIKA KOURA (National Aerospace Laboratory, Chofu, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 3, Dec. 1991, p. 3038-3045. refs

Copyright

The velocity distribution functions (VDF's) in an argon normal shock wave at an upstream high Mach number 7.183 and low temperature 16 K are calculated using the null-collision direct-simulation Monte Carlo method for the Lennard-Jones (LJ) potential to compare with the experimental results of Holtz and Muntz (1983). The convolved VDF's for the LJ potential are in reasonable agreement with the measured data in early and late regions of the shock wave but significantly different in the middle region. This discrepancy cannot be explained by a possible uncertainty in the potential well depth. Moreover, the difference in the convolved VDF's between the LJ potential and the softest and hardest unrealistic molecular models with no attractive force,

i.e., the Maxwell molecule and hard sphere, is much smaller than the discrepancy between the experiments and Monte Carlo calculations. Author

A92-17504

DIRECT SIMULATION MONTE CARLO METHOD APPLIED TO RELEASE FLOW FROM SPACECRAFT

MASAHIRO ISHII Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 31, July 1991, p. 250-253. In Japanese. refs

The Direct Simulation Monte Carlo (DSMC) method was applied to a release flow through an orifice. Spacecraft are required to jettison useless matters in a rarefied-gas phase. For purposes of the analysis of this release flow, the Navier-Stokes equation is not available because of the rarefactional flow, but the Boltzmann equation is useful. The DSMC method provides numerical solution of the Boltzmann equation by directly simulating the movement and collisions of molecules. The release flow was analyzed by means of the DSMC method to obtain the jet shape and the flow rate in the region of Knudsen numbers from 0.1 to 100. The DSMC method applied to polyatomic gas-mixture flows in the intermediate regime also revealed characteristic behavior different from that in the continuous flow. Author

A92-17881

TEMPERATURE CALCULATION OF RECTANGULAR RADIATIVE FINS USING A LINEARIZED METHOD

KATSUHIKO NAKAJIMA, AKIHIRO MIYASAKA, and HIROAKI TSUNODA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 545-550. In Japanese. refs

An infinite series solution presented for a thin rectangular fin is developed for the steady temperature distribution in a two-dimensional rectangular sandwich panel fin heated within a rectangular footprint region, and losing energy to environment by linearized radiation. The solutions approximate a spacecraft application where a heat dissipating electronic component is mounted to a heat-sink plate or an equipment panel. The comparison of numerical results obtained from the proposed method and the lumped nodal method shows that the formulations will be useful in evaluating heat-sink designs where geometry, heat loads, thermal properties, and environmental parameters change frequently. Author

A92-17882

FORMATION OF A UNIFORM LIQUID DROPLET STREAM FOR A LIQUID DROPLET RADIATOR

SHUNSUKE HOSOKAWA, MASAKUNI KAWADA, AKIRA IWASAKI, and ISAO KUDO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 453, 1991, p. 551-557. In Japanese. refs

The liquid droplet radiator uses many streams of droplets to radiate heat to space. A droplet emitter of the liquid droplet radiator produces directed droplets streams from its orifices toward a droplet collector. During flight, droplets lose heat by radiation. In order to constitute an effectively radiative droplet sheath and minimize the working fluid loss at the collector, uniformly formed and spaced droplet streams with good aiming accuracy are required. To investigate the formation of such a uniform droplet stream, and develop the droplet emitter, a laboratory model with a single orifice was made. Diffusion pump oil (DC-704) was used as a working fluid, and squirted out from the orifice by applying pressure. In addition, pressure perturbation was caused by a piezoelectric ceramic to produce uniform droplets from the liquid jet coming out from the orifice. The formation characteristics of the liquid droplet stream was tested in a vacuum, and it was confirmed the liquid droplet stream thus produced reached the required level for the liquid droplet radiator. Author

A92-17925

OBSERVATION OF PERIODIC FLOW THROUGH A CIRCULAR HOLE BY VISUALIZATION

TETSUO NOTOMI, MASANOBU NAMBA, and TAKEHIKO

KIMURA Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Oct. 1991, p. 471-477. In Japanese. refs

The paper presents a visualization study of periodic flows through a circular hole by using the method of hydrogen bubbles. It has been experimentally recognized that there are three flow regimes, i.e., flows with no separation, flows with attached separation bubble and flows with detached vortex rings. The results are in good agreement with author's prediction by numerical analysis. Author

A92-18359

FLUID DYNAMIC EFFECTS OF GROOVES ON CIRCULAR CYLINDER SURFACE

TAKEYOSHI KIMURA and MICHIOHISA TSUTAHARA (Kobe University, Japan) AIAA Journal (ISSN 0001-1452), vol. 29, Dec. 1991, p. 2062-2068. refs

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It is shown that a groove on the surface of a circular cylinder affects movement of the separation point backward and reduces drag even at Reynolds numbers of about a few thousand. Several types of circular-arc cross-section grooves are studied using flow visualizations and numerical simulations. Whether these grooves are effective depends strongly on their positions, and the most effective positions are about 80 deg, measured from the foremost point. When they are effective, cavity flows are developed inside the grooves. This effect corresponds to that of dimples on golf balls and will explain unique characteristics of the drag curve. Author

A92-19958

NUMERICAL SIMULATIONS OF THREE-DIMENSIONAL THERMAL CONVECTION IN A FLUID WITH STRONGLY TEMPERATURE-DEPENDENT VISCOSITY

MASAKI OGAWA (Ehime University, Matsuyama, Japan), GERALD SCHUBERT (California, University, Los Angeles), and ABDELFATTAH ZEBIB (Rutgers University, New Brunswick, NJ) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 233, Dec. 1991, p. 299-328. refs

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A numerical simulation of three-dimensional thermal-convection structure in a fluid with strongly temperature-dependent viscosity filling a bottom-heated rectangular box is presented. It is shown that the convective flow patterns obtained in the numerical simulation are consistent with predictions of Busse and Frick (1985). The planform of the convection obtained for a fluid in a bottom-heated box of aspect ratio $a(x) = 3$ and $a(y) = 1.5$ at $R_{sub} t = 10 \exp 5$ was the same as the one obtained by Travis et al. (1990). I.S.

A92-20327

PRACTICAL METHOD FOR CALCULATING RADIATION INCIDENT UPON A PANEL IN ORBIT

MASAO FURUKAWA (NASDA, Tsukuba, Japan) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 6, Jan.-Mar. 1992, p. 173-177. refs

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The determination of the amount of external radiation incident on flat plates is crucial for the thermal design of satellites in which temperature is passively controlled. A practical method is presented for the numerical computation of radiation input to a radiator panel. Attention is given to both earth-oriented and arbitrarily-oriented panels. O.C.

A92-21719

DIRECT NUMERICAL SIMULATION OF A SUDDENLY-STARTED MIXING SHEAR LAYER

TOSHI FUJIWARA (Nagoya University, Japan) and XIAO WANG Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, Nov. 1991, p. 121-130. refs

Numerical solutions for a forced temporally-developing 2D mixing shear layer are presented. Small perturbations with subharmonic and fundamental modes are superimposed on the unidirectional freestream to show the physics of roll-up and pairing

34 FLUID MECHANICS AND HEAT TRANSFER

of vortices. The phenomena of rolling up, pairing, splitting, and re-pairing processes of large-scale structures are determined, and the evolution of vorticity distribution is demonstrated in terms of vortex pattern. R.E.P.

A92-21724

WAKE MEASUREMENT WITH A LONG HOT-WIRE ANEMOMETER

ETSUO MORISHITA (Tokyo, University, Japan) (Japan Society for Aeronautical and Space Sciences, Journal, vol. 38, no. 442, 1990, p. 591-599) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, Nov. 1991, p. 177-191. Translation. Previously cited in issue 07, p. 1043, Accession no. A91-22166. refs

A92-22525

A DESIGN METHOD OF AXIALLY GROOVED HEAT PIPES EMBEDDED IN EQUIPMENT PANEL FOR COMMUNICATION SATELLITE

AKIHIRO MIYASAKA and KATSUHIKO NAKAJIMA (Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 54-60. In Japanese. refs

A calculation method of the maximum heat load for an axially grooved heat pipe which is embedded in a honeycomb sandwich panel with multipoint heating is developed by considering the estimation of heat flux rate along the heat pipe. A thermal mathematical model for the panel is also used to estimate the net heat input to the heat pipe. The maximum heat loads predicted for the heat pipe embedded in the panel show good agreement with the data obtained from tests which has been performed in a vacuum chamber. A minimum weight design method for rectangular grooved heat pipes which satisfied heat transport capabilities required are also proposed as a result of this study. Author

A92-25388

EVIDENCE AGAINST THE KOLMOGOROV REFINED SIMILARITY HYPOTHESIS

I. HOSOKAWA (University of Electro-Communications, Chofu, Japan) and K. YAMAMOTO (National Aerospace Laboratory, Chofu, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, March 1992, p. 457-459. refs

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It is found that the well-known 'refined similarity hypothesis', proposed by Kolmogorov and Obukhov (1962), fails in a typical direct numerical simulation of three-dimensional turbulence: If r is an inertial-range scale, the velocity difference across a domain of linear dimension r is almost statistically independent of the average dissipation within the domain. This result casts doubt on the often-used relation, $\zeta(p) = p/3 - \mu(p/3)$, between scaling indices $\zeta(p)$ for velocity structure functions and scaling indices $\mu(q)$ for moments of locally averaged dissipation. It seems questionable that a single turbulence model can predict both sets of exponents successfully. Other aspects of the treatment of intermittency in isotropic turbulence may also need reconsideration. Author

A92-25652

ASYMPTOTIC FORMULAS FOR THE SHOCK WAVE OF THE SCALAR CONSERVATION LAW WITH SMOOTH INITIAL DATA KAZUMI TANUMA (Waseda University, Tokyo, Japan) Quarterly of Applied Mathematics (ISSN 0033-569X), vol. 50, March 1992, p. 109-128. Research supported by MOESC. refs

Copyright

The asymptotic expressions are given for the solution at a shock-generation point, a shock-interaction point, and at the time infinity to develop a quantitative statement about the shock wave. The formula by Lax (1957, 1973) is employed to demonstrate the determination of the shock-point location and the behavior of the solution at the point of discontinuity. Asymptotic expansions are developed that provide the shock curve and the entropy solution at the shock-generation point, and the method is applied to cases related to specific shock-interaction times or cases with initial data characterized by compact support. C.C.S.

A92-26121

STATISTICAL MODELING OF COMPRESSIBLE TURBULENCE - SHOCK-WAVE/TURBULENCE INTERACTIONS AND BUOYANCY EFFECTS

AKIRA YOSHIKAWA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4119-4126. refs

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A mass-weighted mean compressible turbulence model is presented with the aid of the results from a two-scale DIA. This model aims at dealing with two typical aspects in compressible flows: the interaction of a shock wave with turbulence in high-speed flows and strong buoyancy effects in thermally-driven flows as in stellar convection and conflagration. The former is taken into account through the effect of turbulent dilatation that is related to the density fluctuation and leads to the enhanced kinetic-energy dissipation. The latter is incorporated through the interaction between the gravitational and density-fluctuation effects. Author

A92-26438

WAKE OF A ROTATING CIRCULAR CYLINDER

TAKEYOSHI KIMURA, MICHIOHISA TSUTAHARA, and ZHONG-YI WANG (Kobe University, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, Feb. 1992, p. 555, 556. refs

Copyright

The present experimental investigation and numerical simulation of two-dimensional flows about a rotating circular cylinder shows that, as the spin parameter increases, wake-meandering decreases in amplitude, and the frequency of the vortices shed by the cylinder increases; at some value of the spin parameter, the meandering disappears. Both of these phenomena are strongly Reynolds-number dependent. Application of the discrete vortex method for simulation of these phenomena leads to the identification of a point-vortices kinematics mechanism. O.C.

A92-26644*

National Aeronautics and Space Administration.

Ames Research Center, Moffett Field, CA.

INSTABILITY MODE INTERACTIONS IN A SPATIALLY DEVELOPING PLANE WAKE

HIROSHI MAEKAWA (Kagoshima University, Japan), NAGI N. MANSOUR, and JEFFREY C. BUELL (NASA, Ames Research Center, Moffett Field, CA) Journal of Fluid Mechanics (ISSN 0022-1120), vol. 235, Feb. 1992, p. 223-254. Research supported by National Research Council and Center for Turbulence Research. refs

Copyright

Direct numerical simulations are used to study the development of various instability modes in a spatially developing 2D wake. Five types of forcing of the inlet are investigated: fundamental mode, fundamental and one or two subharmonics, fundamental mode and random noise, and random noise only. Statistical analyses are carried out, and some numerical results are compared with experimental measurements. I.S.

A92-26795

RESONANCE OF CIRCULAR SHOCK WAVES

MYEONG-KWAN PARK, SHUZO OSHIMA, and RYUICHIRO YAMANE (Tokyo Institute of Technology, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, Feb. 1992, p. 16-22. refs

Copyright

Resonance effects in a supersonic centrifugal compressor or disk MHD power generator have been studied, focusing on oscillation modes of a circular shock wave. The pressure fluctuation components of the higher harmonic modes of the excitation frequency were observed in the downstream stagnation chamber by rotating the valve. Resonance effects were found with the perturbation components of the downstream higher harmonic mode at the natural frequency. Theoretical analysis confirms that resonance occurs when the excitation frequency is equal to the natural frequency of the shock wave. The small perturbation of the higher harmonic modes in the downstream stagnation chamber affected the oscillation modes of the circular shock wave. O.G.

A92-26796

PARTICLE DISPERSION IN A PLANE MIXING LAYER WITH STREAMWISE PRESSURE GRADIENT

HIRONOBU KOBAYASHI (Hitachi, Ltd., Hitachi Research Laboratory, Katsuta, Japan), STEPHEN M. MASUTANI (Pacific International Center for High Technology Research, Honolulu, HI), SHIGERU AZUHATA (Hitachi Ltd., Hitachi Research Laboratory, Katsuta, Japan), and SHIGEKI MORITA (Babcock-Hitachi, Kure Works, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, Feb. 1992, p. 29-37. refs
Copyright

The behavior of heavy particles in an intermittent shear flow has been experimentally studied in a gas-solid, plane mixing layer at a high-speed stream inlet velocity of 10.5 m/s and an inlet velocity ratio of 0.377. Particle and gas velocity statistics were obtained in flows subjected to accelerating, neutral, and adverse pressure gradients. Data indicate that particle dispersion is strongly affected by the large-scale vortical structures of the mixing layer. The streamwise pressure gradient affects particle dispersion through changes induced in the behavior of these vortices. Lateral transport was favored in the flow in the contraction where the mixing layer expands into the particle feedstream. It is suggested that the relative insensitivity of particle turbulent velocities to a pressure gradient may be attributed to the independence of the Stokes number. Particle inertia and the anisotropy of the gas turbulence structure result in large differences in streamwise and transverse particle velocity fluctuations. O.G.

A92-27073#

DRIVEN CAVITY FLOW WITH STABILIZING TEMPERATURE STRATIFICATION

REIMA IWATSU (Institute of Computational Fluid Dynamics, Tokyo, Japan), JAE M. HYUN (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea), and KUNIO KUWAHARA (Institute of Space and Astronautical Science, Sagami, Japan) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992, 11 p. refs
(AIAA PAPER 92-0713) Copyright

The flow and heat transfer properties of a viscous fluid contained in a square cavity have been studied. The major dynamic elements in various regimes of the parameter spaces have been identified using the Navier-Stokes equations with very fine meshes. When $Gr/Re \exp 2$ is less than or equal to 1, the flow features are similar to those of a conventional driven-cavity of a nonstratified fluid. In the bulk of the interior, fluids are well mixed and temperature variations are small. When $Gr/Re \exp 2$ is much greater than 1, many of the middle and bottom portions of the cavity interior are stagnant. Isotherms are nearly horizontal in these regions, and vertically linear temperature distributions are seen. When the Prandtl numbers (Pr) are much less than 1, buoyancy affects the fluid flow throughout the entire cavity. When Pr is much greater than 1, fluid motion is confined within the upper half portion of the cavity. By varying Pr , the relative importance of the convection to the conduction is clearly exhibited. O.G.

A92-27383

AN EXPERIMENTAL ANALYSIS OF OBLIQUE SHOCK REFLECTION OVER A TWO-DIMENSIONAL MULTI-GUTTERED WEDGE

TAKASHI ADACHI, SUSUMU KOBAYASHI, and TATEYUKI SUZUKI (Saitama Institute of Technology, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 9, Jan. 1992, p. 119-132. Research supported by MOESC. refs
Copyright

The oblique shock reflection over a multi-guttered model wedge is investigated at constant Mach number. The experimental parameters were the reflecting wedge angle and the depth of the gutter. It is found that, unlike the case of a smooth surface, the wave structure is not self-similar but similar with respect to the coordinate system made dimensionless by the depth when the wedges are geometrically similar (regardless of Reynolds number based on the depth). Again, unlike the smooth surface, the wave structure is essentially unsteady, and the entire body of waves

reflected from the bottom of the gutters play a key role in the configuration of a precursory reflected wave as well as in the behavior of the triple point. The slope of the triple point trajectory suggests that it approaches asymptotically that for a smooth surface. Author

A92-28940

QUANTIZED VORTICES IN TWO-DIMENSIONAL SUPERFLUIDS AND GENERALIZED HAMILTONIAN DYNAMICS

HIROSHI KURATSUJI (Ritsumeikan University, Kyoto, Japan) Physical Review Letters (ISSN 0031-9007), vol. 68, March 16, 1992, p. 1746-1749. Research supported by Inamori Foundation. refs

Copyright

Using the functional integral for many-boson systems, a new formulation of quantum vortices in 2D superfluids is proposed. The motion of vortices is described by a generalized Hamiltonian dynamics in which the equation of motion is governed by a deformed canonical structure. The quantum correspondence of this unusual feature is realized by the anomalous commutators for vortex coordinates. In terms of a semiclassical language, this anomaly yields a consequence that vortex quanta behave like 'anyons'. Author

A92-28989

A TAYLOR-GALERKIN-BASED FINITE ELEMENT METHOD FOR TURBULENT FLOWS

CHUN B. JIANG, MUTSUO KAWAHARA, and KAZUO KASHIYAMA (Chuo University, Tokyo, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 9, Feb. 1992, p. 165-178. refs
Copyright

A finite element method is applied to solve the two-dimensional turbulent channel flows. Based on the fractional step techniques, the momentum and the k-epsilon equations are split into convection and diffusion equations. The convection equations are solved by the second-order Taylor-Galerkin finite element method, which can overcome the spurious oscillations with minimal artificial diffusion, and the diffusion equations are solved by the fully explicit Galerkin method. Since the same order interpolation is used for the velocity, pressure and turbulent quantities, the present method is computationally efficient. The sudden expansion flow and the obstructed turbulent channel flow are studied. The results are in good agreement with experimental observations. Author

A92-29654

COHERENT STRUCTURE OF A D-TYPE ROUGH WALL BOUNDARY LAYER IN A FULLY ROUGH REGIME (ANALYSIS WITH THE VITA TECHNIQUE)

SHINSUKE MOCHIZUKI and HIDEO OSAKA Yamaguchi University, Faculty of Engineering, Memoirs (ISSN 0372-7661), vol. 42, Oct. 1991, p. 1-6. In Japanese. refs
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The coherent structure of a d-type rough-wall-boundary layer at a momentum-thickness Reynolds number of 5000 is investigated experimentally. The conditional averaged signals and mean bursting frequency were obtained with the VITA technique. The results show that the bursting phenomenon does exist even in the present rough wall flow. However, the intensity of ejection process is smaller than that of the d-type rough wall flow at a Reynolds number of 800. The mean bursting frequency nondimensionalized with the wall units takes almost the same value both in the present flow and the smooth wall flow. Author

A92-29655

STUDIES OF FOCUSING PROCESS OF WEAK SHOCK WAVES

KOJI IZUMI, TERUYUKI NAKAJIMA, SHIGERU ASO, and MICHIO NISIDA Kyushu University, Technology Reports (ISSN 0023-2718), vol. 64, Dec. 1991, p. 579-585. In Japanese. refs

This paper describes numerical and experimental studies on the focusing process of a weak shock wave reflected from a concave parabolic wall. Experiments were carried out using a conventional shock tube with air as test gas at an incident shock Mach number of 1.1. In the experiments, shock waves were

visualized by a Schlieren technique. Numerical studies were done using a two-dimensional inviscid flow model. Numerical results were compared with the experimental ones for various reflector shapes and satisfactory agreement were obtained. Author

A92-30416

STUDY ON DYNAMICAL PROPERTIES OF INTERMITTENT PHENOMENA IN TURBULENT BOUNDARY LAYER

YOSHIYUKI TSUJI, KATSUYA HONDA (Nagoya University Japan), SHINICHI SATO (Shizuoka University, Japan), and IKUO NAKAMURA (Nagoya University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, Jan. 1992, p. 10-14. refs

Copyright

Following the idea proposed previously that describes the phenomena observed in the outer region of the turbulent boundary layer in terms of a one-dimensional map generating the intermittent chaos, it is attempted to analyze the problem with the use of statistical mechanical methodology applied frequently to dynamical systems. From the binary sequences constructed by processing measured data of instantaneous streamwise velocities, the singularity spectrum or the fluctuation of the dynamical scaling indices are obtained. In particular, the Kolmogorov entropy is given quantitatively as a function of the distance from the wall. The difference from random motions is emphasized. Author

A92-30419

A SINGULARITY-FREE EXPANSION METHOD FOR NONLINEAR DRIFT WAVE VORTEX IN SHEAR FLOW

HIROFUMI MORIGUCHI and KAZUHIRO NOZAKI (Nagoya University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, Jan. 1992, p. 117-130. refs

Copyright

In the Hasegawa-Mima equation, steady drift wave solutions representing a localized (solitary) vortex in the shear flow are examined by a singularity-free expansion method, in which total flow is expanded around the shear flow. It is shown that singular terms, caused by the 'resonance' between the traveling velocity of the vortex and the shear flow, appear in the expansion of the two-dimensional nonlinear equation for the vortex moving steadily. If a singularity-free condition is imposed on a certain order coefficient of the expanded equation, the lower-order coefficients are uniformly bounded while the higher-order coefficients vanish. Analyzing the exactly truncated equation, piecewise continuous solutions of Larichev-Reznik's type are obtained and the existence of a smooth monopole of solitary vortex in the shear flow in the whole plane is shown. Author

A92-30501

FLUID DYNAMICS CONFERENCE, 22ND, OSAKA, JAPAN, NOV. 15, 1990, PROCEEDINGS

Conference sponsored by Japan Society for Aeronautical and Space Sciences. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, 257 p. In Japanese and English. For individual items see A92-30502 to A92-30560.

Papers are presented on such topics as supersonic multiphase flow, continuum and rarefied gas flow, the numerical simulation of hypersonic rarefied gas flow around a reentry vehicle, the DSMC analysis of hypersonic rarefied gas flow, application of the null collision direct simulation Monte Carlo (DSMC) methods, the use of 2D curved pipes to reduce shock waves, and shock wave diffraction at a 90-deg corner. Consideration is also given to a numerical study of mixing layer control, numerical simulation of hypersonic flow around HOPE, the unstructured upwind method, boundary layer flow around a cylinder, evaporation and condensation of a polyatomic molecular gas flow, a study of cavity pumping in supersonic internal flow, computation of scramjet inlet flow, and a numerical analysis of laminar flow control of transonic airfoils. Y.P.Q.

A92-30503

PROBLEMS OF CONTINUUM AND RAREFIED GAS FLOWS

JU HOBARA (Nagoya University, Japan) IN: Fluid Dynamics

Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. S-16 to S-19. In Japanese.

The problems of low velocity continuum flow along a parallel plate and supersonic rarefied gas flow around a cylinder are discussed. The direct simulation Monte Carlo (DSMC) method is used to calculate the flows. Numerical calculation of the total variation diminishing (TVD) method is also used. Y.P.Q.

A92-30506

DIRECT SIMULATION OF EFFUSION AND EXPANSION FROM A SLIT INTO A VACUUM

BYUNG G. KIM and TAKEO SOGA (Nagoya University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 10-13. refs

Effusion flows from a 1D porous slit and expansion flows from a sonic slit were studied based upon the DSMC method. The effusion flow was accelerated to a supersonic expansion flow but the equivalent stagnation pressure was much less than the pressure at the slit. Features of the effusion flow with back flow were revealed. The back flow seemed to be separated from the main flow and its effects on the main flow were less significant. Present simulations showed that the cell size in the direction of expansion (perpendicular to the slit surface) should be equal or less than 4 mean free paths pertinent to the sonic condition. Author

A92-30510

NUMERICAL SIMULATION OF BLAST WAVES, TAKING TOPOGRAPHY INTO ACCOUNT

SHIGEO SHIMIZU (Tokyo Nogyo University, Japan), KOZO FUJII, T. TAMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and FUMIO HIGASHINO (Tokyo Nogyo University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 24-27. In Japanese. refs

A92-30511

NUMERICAL INVESTIGATION OF UNSTEADY COMPRESSIBLE FLOW WITH MOVING SHOCK WAVES

KEISUKE SAWADA (Tohoku University, Sendai, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 28-31. refs

Inviscid compressible flows containing moving shock waves and contact surfaces are investigated numerically. The second order accurate TVD scheme and the second order accurate ENO scheme are used. A multidimensional extension of MUSCL approach is also formulated to reduce the possible grid dependence of the conventional dimensionally splitting schemes and to construct a truly multidimensional, uniformly higher order accurate finite volume scheme. Author

A92-30512

USING TWO-DIMENSIONAL CURVED PIPES TO REDUCE SHOCK WAVES

TOMOHIRO USUI and HIROKI HONMA (Chiba University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 32-35. In Japanese. refs

Reflections of weak shock waves in two-dimensional curved pipes are examined. The McCormack-FCT combined method is used for the basic equations and numerical calculation. Isopycnic linear graphs of the pipes are presented. Y.P.Q.

A92-30513

SHOCK WAVE DIFFRACTION AT A 90 DEGREE CORNER

TAKAMIYAKI YASUYASHI (National Aerospace Laboratory, Chofu, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 36-39. In Japanese. refs

Characteristics of shock waves diffraction at a 90-deg corner

are examined. Numerical calculation of the shock waves is presented. The shapes of the diffracting shock waves are examined. Y.P.Q.

A92-30514

NUMERICAL INVESTIGATION OF MIXING LAYER CONTROL
OSAMU INOUE, S. ONUMA, and KEISUKE SAWADA (Tohoku University, Sendai, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 40-43. In Japanese. refs

The mixing layer control of turbulent flow is simulated. A two-dimensional vortex method is given for the artificial control of the turbulent mixing layers. Test results on two cases are studied. Y.P.Q.

A92-30515

STUDIES ON AN ARTIFICIAL SPIRAL VORTEX

Y. OHAMA, Y. FUKUNISHI, and CONGRONG WANG (Tohoku University, Sendai, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 44-47. In Japanese. refs

The test equipment and measurement method for the investigation of an artificial spiral vortex are determined. Test results show the visualization of the formation of travelling vortices. Acoustic frequencies are also determined. Y.P.Q.

A92-30516

NUMERICAL ANALYSIS OF TURBULENT FLOW AROUND A CYLINDER

SUSUMU HAKUSAN (Institute of Computational Fluid Dynamics, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 48-51. In Japanese. refs

A computational fluid dynamics analysis applied to the turbulent flow around a cylinder is presented. A numerical calculation of the unsteady flow is presented. Y.P.Q.

A92-30524

BOUNDARY LAYER FLOW AROUND A CYLINDER

SHIAKI ONO, TETSURO TAMURA (Nihon University, Tokyo, Japan), and KUNIO KUWAHARA (Shimizu Corp., Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 84-87. In Japanese. refs

Numerical computation in connection with a wind tunnel test is presented. Test equipment and measuring conditions are given and boundary layer flow around a cylinder is emphasized. The Neumann problem is discussed. Y.P.Q.

A92-30529

WALL-FLOW COLLISION OF A TRANSVERSE JET CAUSES THREE-DIMENSIONAL FLOW

YOSHIYUKI SUGIYAMA and MICHIO KOJIMA (Nagoya University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 104-107. In Japanese. refs

The wall-flow collision of a transverse jet is examined. The constant velocity line of the symmetric plane and vector is investigated. Y.P.Q.

A92-30534

BOLTZMANN-EQUATION ANALYSIS OF RAREFIED GAS FLOW AND THERMAL STRESS SLIP FLOW

HIROSHI OWADA and YOSHIO SONE (Kyoto University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 124-127. In Japanese. refs

The Boltzmann equation is given for the analysis of rarefied gas flow. The thermal stress slip coefficients and Knudsen layer are investigated. The Boltzmann-Krook-Welander (BKW) model is also discussed. Y.P.Q.

A92-30543

SHOCK-WAVE SIMULATION FOR AN ASYMMETRIC SUPERSONIC JET

W. HIGASHINO, SHIGERU MATRUO (Tokyo Nogyo University, Japan), and T. TSUYUKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 160-163. In Japanese. refs

The Baldwin-Lomax turbulent flow model is used for shock-wave simulation. The asymmetric supersonic nozzle shape and pressure are measured. Y.P.Q.

A92-30544

NUMERICAL SIMULATIONS OF SHOCK WAVE REFLECTION BY A THIN LAYER NAVIER-STOKES EQUATION

SHIGERU ASO (Kyushu University, Fukuoka, Japan), MASANORI TAKANO (Toyota Automobile Co., Ltd., Japan), and M. HAYASHI (Nishinoh Institute of Technology, Fukuoka, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 164-167. In Japanese. refs

The two-dimensional thin layered Navier-Stokes equations for shock wave reflection are presented. The numerical computation of the pressure distribution and surface friction distribution are discussed. Weak shock wave reflections are analyzed. Y.P.Q.

A92-30545

REFLECTED SHOCK WAVE EFFECTS IN COMBUSTIBLE FLOW

YASUNARI TAKANO (Tottori University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 168-171. In Japanese. refs

Numerical simulation of a reflected shock wave associated with detonation phenomena is presented. Two-dimensional thin layer Navier-Stokes equations are used for the calculation. The density inside the shock tube is also computed. Y.P.Q.

A92-30548

CALCULATION OF LIGHT EMISSION BEHIND INTENSE SHOCK WAVES IN AIR

HIROYUKI IISUKA and H. HONMA (Chiba University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 180-183. In Japanese. refs

Calculation results on the distribution of light emission energy behind intense shock waves is presented with reference to electron-impact vibrational excitation in the flow field around a space vehicle. Particular attention is given to phenomena in the flow field of an aeroassisted orbital transfer vehicle. Y.P.Q.

A92-30554

DRAW OF TWO-DIMENSIONAL VERTICAL GRIDS IN UNIFORM FLOW

M. ITO and M. UEDA (Meiji University, Kawasaki, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 204-207. In Japanese. refs

Drag coefficients of vertical grids are investigated. The pressure distribution around the grids is measured, and the velocity of uniform flow is calculated. Y.P.Q.

A92-30556

NUMERICAL SIMULATION OF SURFACE FLOW AROUND AN OBJECT

SHIGERU ASO and A. SAKAMOTO (Kyushu University, Fukuoka, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 212-215. In Japanese. refs

The characteristics of the surface flow around a cylinder are computed for different Reynolds numbers. The flow pattern around

34 FLUID MECHANICS AND HEAT TRANSFER

a wing is investigated, and the computational grids for both flow patterns are presented. Y.P.Q.

A92-31459

OVER-REFLECTION AND SHEAR INSTABILITY IN A SHALLOW-WATER MODEL

SHIN-ICHI TAKEHIRO and YOSHI-YUKI HAYASHI (Tokyo, University, Japan) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 236, March 1992, p. 259-279. refs
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The present study of shallow-water wave characteristics in a linear shear flow gives attention to the relationship between waves and unstable modes. The numerical integration of the linear equations reveals a phenomenon of overreflection, when a wave packet is incident at the turning surface, which can be accounted for in terms of Acheson's (1976) characterization of momentum conservations. Unstable linear shear flow modes in shallow water first observed by Satomura (1981) are presently described in terms of Lindzen's (1988) wave propagation properties. O.C.

A92-31464

A NUMERICAL STUDY OF VORTEX SHEDDING FROM FLAT PLATES WITH SQUARE LEADING AND TRAILING EDGES

YUJI OHYA, YASU HARU NAKAMURA, SHIGEHIRA OZONO, HIDEKI TSURUTA (Kyushu University, Kasuga, Japan), and RYUZO NAKAYAMA (Kitakyushu, National Technical College, Japan) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol. 236, March 1992, p. 445-460. refs
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This paper describes a numerical study of the flow around flat plates with square leading and trailing edges on the basis of a finite-difference analysis of the 2D Navier-Stokes equations. The chord-to-thickness ratio of a plate, d/h , ranges from 3 to 9, and the value of the Reynolds number based on the plate's thickness is constant and equal to 1000. The numerical computation confirms the finding obtained in previous experiments that vortex shedding from flat plates with square leading and trailing edges is caused by the impinging-shear-layer instability. In particular, the Strouhal number based on the plate's chord increases stepwise with increasing d/h in agreement with the experiment. Numerical analyses also provide some crucial information on the complicated vortical flow occurring near the trailing edge in conjunction with the vortex shedding mechanism. The mechanism of the impinging-shear-layer instability is discussed in the light of the experimental and numerical findings. Author

A92-31497

HIGHER-ORDER SOLUTIONS OF SQUARE DRIVEN CAVITY FLOW USING A VARIABLE-ORDER MULTI-GRID METHOD

HIDETOSHI NISHIDA and NOBUYUKI SATOFUKA (Kyoto Institute of Technology, Japan) (International Association for Computational Mechanics, World Congress of Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990) *International Journal for Numerical Methods in Engineering* (ISSN 0029-5981), vol. 34, March 30, 1992, p. 637-653. refs
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A new higher-order method is devised for the numerical simulation of square driven cavity flows. The spatial derivatives of the Navier-Stokes equations are discretized by means of the modified differential quadrature method. The resulting system of ordinary differential equations in time is then integrated by the classical fourth-order Runge-Kutta-Gill scheme. The elliptic (Poisson) equation is solved by means of a new variable-order multigrid method. The numerical simulations of the square driven cavity flows are carried out with spatial order of accuracy up to 10th order. The results suggest that the higher-order solutions are more reliable than the well-known results obtained by Ghia et al. Author

A92-32508

A STUDY ON THE ROTATING STALL OF CENTRIFUGAL COMPRESSORS. II - EFFECT OF VANELESS DIFFUSER INLET SHAPE ON ROTATING STALL

HIROMI KOBAYASHI, HIDEO NISHIDA, TAKEO TAKAGI, and YASUO FUKUSHIMA Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2646-2651. In Japanese. refs

Rotating stall induced in a vaneless diffuser is examined. Combinations of several low-specific-speed impellers and three types of diffusers with different inlet shape are tested. In the lower specific-speed stages, the critical inlet-flow angle for rotating stall depends not only on diffuser width ratio and contraction ratio, but also on the inlet shape of the diffuser. As the inlet shape parameter becomes smaller than value of 0.1, the critical inlet-flow angle becomes larger than the predicted value by the Senoo method. The empirical prediction formula of critical inlet-flow angle in the first report is corrected by considering the influence of inlet shape. Influence of inlet shape on rotating stall phenomenon is also shown. Author

A92-32510

FLUID FLOW AND HEAT TRANSFER AROUND A RECTANGULAR CYLINDER IN A FLAT PLATE LAMINAR BOUNDARY LAYER

TAMOTSU IGARASHI and HIROMI TAKASAKI Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2759-2766. In Japanese. refs

Experiments were performed to investigate the fluid flow and heat transfer around a rectangular cylinder in a flat plate laminar boundary layer. The height of the cylinder H was varied and the width c was constant. The Reynolds number, ranged from 3,800 to 12,000 and the value of the ratio H/δ was varied from 0.48 to 5.2, where δ is the thickness of the laminar boundary layer without the cylinder. The local heat-transfer coefficients on each face were measured and discussed in relation to the fluid flow, that is, the flow visualization and the turbulent intensity around the cylinder. The flow pattern on the upper side of the cylinder changes from laminar flow type to separation and reattachment flow types increasing the value of H/δ . The heat transfer performance corresponds to these flow patterns. Author

A92-32511

NEW NUMERICAL METHOD FOR COMBINED CONVECTIVE-RADIATIVE HEAT TRANSFER

TOSHIO MIYAUCHI, TOSHIO ITONAGA, MASAHIRO HIRANO, and YOSHIKAZU TAKAHIRA Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2767-2773. In Japanese. refs

The problems involved in numerical methods for convective-radiative heat transfer are discussed, and by changing the grid points, a method is developed based on the partial differential equation which can be applicable to the radiation dominant region. A numerical method is proposed which quasi-linearizes the radiative term. This method has the advantage that the computational time is short and the calculation speed shows weak dependence on the relaxation parameter. Author

A92-32512

A SUPPLEMENTARY STUDY OF IGNITION PHENOMENA OF SPRAYS USING A SHOCK TUBE

YUKIO MIZUTANI, JIN D. CHUNG, and KAZUYOSHI NAKABE Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2802-2807. In Japanese. refs

When a column of cetane droplets freely falling from an ultrasonic atomizer is ignited behind a reflected shock, no ignition occurs at a temperature below about 1100 K even if the pressure is sufficiently high. Although a higher temperature ensures ignition, no flame so luminous as to be recorded by high-speed photography appears, and even if a luminous flame lump appears, it disappears without spreading throughout the droplets column. If, on the other hand, fuel is injected into a diesel cylinder or an electric furnace, ignition occurs even at a temperature as low as 650 K with a luminous flame spreading over the entire spray. Supposing that the above difference resulted from the difference in intensity of turbulent mixing of droplets with hot air, turbulence-generating rods

were placed on the upstream side of the spray column. As a result, the ignition limit was lowered down to about 840 K, and the combustion mode shifted from a blue-flame mode or locally confined ignition mode into an ordinary spray combustion mode.

Author

A92-34820

ON ALGEBRAIC EXPRESSION FOR THE REYNOLDS STRESSES

T. IKOHAGI and H. DAIGUJI (Tohoku University, Sendai, Japan) IN: Advances in numerical simulation of turbulent flows; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 11-15. refs

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Algebraic expressions for the Reynolds stresses are deduced from the Reynolds stress model for turbulent shear flow at high Reynolds number. By means of an algebraic technique for the convection-diffusion terms and an expansion in time-scale of turbulence k/ϵ , higher-order expressions can be obtained successively. The second-order expressions are shown to be consistent with the existing anisotropic k - ϵ model based on a turbulence theory. Without any computer optimization, all the model constants can be determined by using experimental data of homogeneous turbulent shear flow. The third-order expressions are examined with LES database for a turbulent mixing layer.

Author

A92-34824

ASSESSMENT OF K-EPSILON MODEL USING LES DATA ON THE FLOW OVER BACKWARD FACING STEP

YOUHEI MORINISHI and TOSHIO KOBAYASHI (Tokyo, University, Japan) IN: Advances in numerical simulation of turbulent flows; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 43-47. refs

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The turbulent flow over the backward facing step of the step ratio 1.5 is computed by the k - ϵ model using the isotropic and anisotropic expression models for the Reynolds stress. The Reynolds number based on the step height and the main flow is 46,000. The computational results of the k - ϵ model are compared with the LES data and discussed. Although the anisotropic expression model does not significantly improve the prediction of the reattachment length, this model predicts the turbulent kinetic energy or the turbulent intensities in the recirculating zone and the wall pressure distributions that are related to the normal stress.

Author

A92-34825

LARGE EDDY SIMULATION OF UNSTEADY TURBULENT WAKE OF A CIRCULAR CYLINDER USING THE FINITE ELEMENT METHOD

CHISACHI KATO and MASAHIRO Ikegawa (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Ibaraki, Japan) IN: Advances in numerical simulation of turbulent flows; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 49-56. refs

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A novel streamline FEM formulation is used by the present large-eddy simulation of a circular cylinder's turbulent wake at a subcritical Reynolds number, in order to obtain time-accurate solutions of the governing equations. The wake's transition to turbulence is modeled by a damping of the subgrid-scale eddy viscosity in a region near the cylinder surface. The results obtained exhibit a three-dimensionality in the region behind the cylinder, as a result of which the calculated fluctuating-lift coefficient is about one-fourth that of 2D calculations. The drag coefficient, Strouhal

number, and fluctuating lift coefficient obtained are in substantial agreement with experimental results.

O.C.

A92-35712

INITIAL BOUNDARY VALUE PROBLEMS FOR ISENTROPIC GAS DYNAMICS

SHIGEHARU TAKENO (Niigata University, Japan) Royal Society (Edinburgh), Proceedings, Section A (ISSN 0308-2105), vol. 120, pt. 1-2, 1992, p. 1-23. refs

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A compensated compactness theory and a difference scheme analysis are used to prove convergence theorems for a difference scheme for piston problems in isentropic gas dynamics. A procedure for constructing an approximate solution of the Godunov type for the piston problems considered is described.

V.L.

A92-35991

CONTROL OF THE REATTACHMENT PROCESS BY THE FENCE IN A BACKWARD-FACING STEP FLOW

YASUNORI KANAORI and SHINJI HONAMI (Tokyo, Science University, Japan) IN: Forum on Turbulent Flows - 1991; ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991, Proceedings. New York, American Society of Mechanical Engineers, 1991, p. 51-55. Research supported by MOESC. refs

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A basic backward-facing step flow was perturbed by a fence installed upstream of the step. The fence installation looks to be the multistep concept to enhance the turbulent mixing. The tests were conducted by changing fence height in order to control the reattachment process. Detailed measurements on the forward flow fraction, mean velocity and turbulence intensity, and the frequency spectra were made in a shear layer near the step and in the downstream locations. The reattachment length strongly depends on the fence height. The structures in the inner shear layer are strongly influenced by an inherent turbulent mixing, while those of the outer shear layer are not altered even in the downstream location.

Author

A92-35996

OPTIMUM SUPPRESSION OF FLUID FORCES ACTING ON A CIRCULAR CYLINDER AND ITS EFFECTIVENESS - CONTROLLED BY A FINE CIRCULAR CYLINDER

HIROSHI SAKAMOTO and HIROYUKI HANIU (Kitami Institute of Technology, Japan) IN: Forum on Turbulent Flows - 1991; ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991, Proceedings. New York, American Society of Mechanical Engineers, 1991, p. 101-106. refs

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An investigation is conducted of the suppression of the fluid forces acting on a circular cylinder by controlling the flow around it. The control of the flow is established by introducing a fine circular cylinder near the main cylinder. The steady and unsteady fluid forces, flow pattern, and vortex shedding frequency are then systematically examined.

R.E.P.

A92-36005

METAMORPHOSIS OF ARTIFICIALLY-GENERATED ORDERED MOTIONS IN THE TRANSITION PROCESS OF A TWO-DIMENSIONAL WAKE

HIROSHI SATO (Institute of Flow Research, Tokyo, Japan) IN: Boundary layer stability and transition to turbulence; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 13-16. refs

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Results of a wind tunnel study aimed at investigating the origin of ordered motion in a turbulent wake are reported. In the experiments, a two-dimensional wake was formed behind a metal screen placed normal to the uniform flow. The pattern intensity decreased downstream, but the probability density function of correlation peaks indicates the existence of strong patterns in the

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apparently turbulent wake. This suggests that at least some of the ordered motions in turbulent flows are produced in the transition region. V.L.

A92-36015

THREE-DIMENSIONAL INSTABILITY IN ROTATING BOUNDARY LAYER

MASAHARU MATUBARA and SHIGEAKI MASUDA (Keio University, Yokohama, Japan) IN: Boundary layer stability and transition to turbulence; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 103-107. refs

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In a rotating boundary layer with the axis of rotation parallel to the leading edge, the Coriolis force acting toward the surface leads to the three-dimensional instability. The visual investigation shows that longitudinal vortices are generated and break down in accordance with secondary instability. This process is analogous to Goertler vortices on a concave wall. The linear stability calculation shows Taylor Goertler type instability, and the dependence of the wavelength on the rotational speed shows qualitative agreement with measurements. Author

A92-36016* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A NEW PARAMETER FOR PREDICTING CROSSFLOW INSTABILITY

Y. KOHAMA (Tohoku University, Sendai, Japan) and S. DAVIS (NASA, Ames Research Center, Moffett Field, CA) IN: Boundary layer stability and transition to turbulence; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 109-114. refs

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Instability of boundary-layer over a concave wall and a rotating disk which were thought to be essentially different in instability sources, are compared in order to investigate whether or not a single crossflow parameter can be defined. Using a newly defined crossflow parameter, prediction was attempted on a yawed cylinder boundary-layer transition. By comparing the calculation with experiment, it was found out that this parameter can document fairly well the onset condition of the crossflow instability. Author

A92-36024

INSTABILITIES AROUND AN ISOLATED ROUGHNESS ELEMENT

TATSUO MOTOHASHI, KIYOAKI ONO (Nihon University, Tokyo, Japan), TETSURO TAMURA (Shimizu Corp., Tokyo, Japan), and KUNIO KUWAHARA (Institute of Space and Astronautical Science, Kanagawa, Japan) IN: Boundary layer stability and transition to turbulence; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 179-183. refs

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The flow downstream of an isolated roughness element was studied in a small wind tunnel using hot-wire anemometry. The near velocity field of the roughness element is characterized by a high shear layer in the spanwise direction; the background shear stress of the laminar boundary layer is of the same order as the spanwise shear one. The results suggest that the instability of the spanwise structure is the main factor determining flow near the roughness element and that the vortex instability is induced by the trailing vortices. V.L.

A92-36037

OUTFLOW BOUNDARY CONDITIONS FOR EULER ANALYSIS OF FLOW IN TURBINE SCROLL

M. FURUKAWA, K. FUKUI, K. HARA, and M. INOUE (Kyushu University, Fukuoka, Japan) IN: Numerical simulations in turbomachinery; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27,

1991. New York, American Society of Mechanical Engineers, 1991, p. 81-87. refs

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Three schemes for outflow boundary conditions are applied to the Euler analysis of 2D flow in the vaneless turbine scroll in order to clarify what conditions should be specified at the scroll exit where the flow cannot be assumed to be uniform. In scheme A, the upstream-running Riemann invariant is specified and the entropy, tangential velocity, and downstream running Riemann invariant are extrapolated at the outflow boundary. In scheme B the static pressure is specified and the density and momentum fluxes in the x and y directions are extrapolated at the outflow boundary. In scheme C, the same scheme as B is performed at the first step and the circumferential split governing equations obtained by the time split approximation are integrated at the second step. Scheme A is found to be more suitable for the outflow boundary treatment of the turbine scroll than the others. Scheme A also exhibits a better convergence than the others. C.D.

A92-36190

SPATIOTEMPORAL INTERMITTENCY AND INSTABILITY OF A FORCED TURBULENCE

SHIGEO KIDA and KOJI OHKITANI (Kyoto University, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 5, May 1992, p. 1018-1027. Research supported by MOESC. refs

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The time development of an infinitesimal disturbance and the relation to the spatiotemporal intermittency of a developed turbulence is studied by solving numerically the Navier-Stokes equation and its linearized form. A high-symmetric flow is integrated by the use of the spectral method with 340 exp 3 effective modes to realize a developed turbulent field with Reynolds number of about 186 which is in statistically stationary state. Energy transfer in the wavenumber space is not uniform in time but quiescent, and active periods of energy transfer and of the energy dissipation rate occur repeatedly in a large-scale eddy-turnover time. Vorticity tends to be concentrated in long thin tubelike regions, and the energy dissipation field forms double peaks around a tube, which resembles a flow around a nonaxisymmetric Burgers vortex. Both the energy and the enstrophy of the disturbance field increase exponentially in time with growth rate comparable to the reciprocal of the time scale of the peak wavenumber of the energy dissipation spectrum. The energy spectrum of the disturbance field shows an equipartition of energy at small wavenumbers including the inertial range. The disturbance vorticity field has a dipole structure at the position of a vorticity concentrated tube. Author

A92-36198

VARIABLE SOFT SPHERE MOLECULAR MODEL FOR AIR SPECIES

KATSUHIKA KOURA and HIROAKI MATSUMOTO (National Aerospace Laboratory, Chofu, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 5, May 1992, p. 1083-1085. refs

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A reliable set of cross-section parameters of the variable soft sphere (VSS) molecular model is determined for the Monte Carlo simulation of air species from the transport collision integrals or potential parameters provided by Cubley and Mason (1975) over the high-temperature range 300-15,000 K. The VSS cross-section parameters for the inverse-power-law potential are also determined from the viscosity coefficients recommended by Maitland and Smith (1972) for common species in the low (20-300 K) and high (300-2000 K) temperature ranges. Author

A92-36199

COMMENT ON THE DISSIPATION-RANGE SPECTRUM IN TURBULENT FLOWS

TSUTOMU SANADA (Institute of Computational Fluid Dynamics, Tokyo, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 5, May 1992, p. 1086, 1087. refs

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Recently, Smith and Reynolds (1991) suggested that the

turbulent energy spectrum with an exponential decaying form may be a poor model, because it does not give velocity derivative skewness in good agreement with experimental value. On the other hand, some direct numerical simulations of the Navier-Stokes equation demonstrate this exponential form in the dissipation range. This agreement is resolved by considering a model spectrum based on direct numerical simulation. Author

A92-36351

ACTIVE CONTROL OF THE HYDRAULIC FORCES OF A BODY BY A SPLITTER PLATE

NORIO ARAI and MASATOMO KOMATSU (Tokyo Noko University, Koganei, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 145-150. refs

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The present article investigates numerically the structure of the wake behind a square-section cylinder mounted with a splitter plate. The two-dimensional Navier-Stokes equation is solved numerically. The interaction between the transverse flow (behind the body) and the splitter has considerable influence on the rearrangement of the vortex street. With the splitter plate suitably located, the peak of the lift coefficient is reduced to 40 percent of the isolated body case. Also, the frequency of the variation of the lift coefficient becomes smaller. It is found that there is an optimal location for the splitter plate. Author

A92-36352

A DISCUSSION ON EDDY VISCOSITY MODELS ON THE BASIS OF THE LARGE EDDY SIMULATION OF TURBULENT FLOW IN A SQUARE DUCT

TAKEO KAJISHIMA and YUTAKA MIYAKE (Osaka University, Suita, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 151-161. refs

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The origin of the turbulence driven secondary flow and the validity of the eddy viscosity models for prediction of the turbulent flow in a noncircular duct are presented on the basis of large eddy simulation computation. The secondary flow is developed as a result of the delicate imbalance between the gradient of the turbulence stress and that of the corresponding pressure in the region very close to the corner wall. The time-averaged flow field and the turbulence quantities acquired are in good agreement with the available experimental data for the higher Reynolds number case. The finely resolved turbulent flow field is obtained for the lower Reynolds number case. R.E.P.

A92-36353

APPLICATION OF AN IMPLICIT TIME-MARCHING SCHEME TO A THREE-DIMENSIONAL INCOMPRESSIBLE FLOW PROBLEM IN CURVILINEAR COORDINATE SYSTEMS

T. IKOHAGI, B. R. SHIN, and H. DAIGUJI (Tohoku University, Sendai, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 163-175. refs

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An implicit finite-difference scheme based on the SMAC method for solving steady three-dimensional incompressible viscous flows is proposed. The three-dimensional incompressible Navier-Stokes equations in general curvilinear coordinates, in which the contravariant velocities and the pressure are used as the unknown variables, have been derived by the authors. The momentum equations for the contravariant velocity components and the elliptic equation for the pressure are solved directly in the transformed space by applying the delta-form approximate-factorization scheme and the Tschebyscheff SLOR method, respectively. The present implicit scheme is stable under correctly imposed boundary conditions, since the spurious error and the numerical instabilities

can be suppressed by satisfying the continuity condition identically, and by employing the staggered grid and the TVD upwind scheme. Some numerical results for three-dimensional flow over a backward-facing step are shown to demonstrate the reliability of the present scheme and to clarify the three-dimensional effects of such complex flows. Author

A92-36354

NUMERICAL SIMULATION OF A LOW-MACH-NUMBER FLOW WITH A LARGE TEMPERATURE VARIATION

YASUYOSHI HORIBATA (Toshiba Corp., Systems and Software Engineering Laboratory, Kawasaki, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 185-200. refs

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Compressibility is important in a low-Mach-number flow with a large temperature variation. However, it is well known that time-dependent compressible flow schemes become ineffective at low Mach numbers. This ineffectiveness occurs because a wide disparity exists between the time scales associated with convection and the propagation of acoustic waves. For this reason, scale analysis modifies the compressible equations in order to remove acoustic waves from them. The pressure is divided into the thermodynamic and dynamic parts. The density variation caused by the variation in the dynamic part is neglected. The scale analysis shows the conditions under which the modified equations are applicable. Examination of small-amplitude waves show that the modified equations contain internal gravity waves (buoyant effects), while they exclude acoustic waves. Similarly to the modified equations, the Boussinesq equations are derived under a further condition. A finite difference scheme integrates the modified equations. The scheme is essentially the MAC method. First, thermal convection of a Boussinesq fluid in a square cavity is simulated in order to validate the calculation method. The result is in good agreement with a benchmark solution. Second, thermal convection with a large temperature variation is simulated in a vertical pipe furnace used for the heat treatment of semiconductor wafers. An axisymmetric steady flow is obtained. Author

A92-36355

NUMERICAL ANALYSIS OF THE NONSTATIONARY OBLIQUE REFLECTION OF WEAK SHOCK WAVES

HIROKI HONMA, HIROHIKO MAEKAWA, and TOMOHIRO USUI (Chiba University, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 201-210. refs

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Numerical calculations are performed for the oblique reflection of weak shock waves with finite thickness from a wedge. Three models of broad shock fronts are considered: dispersive waves due to vibrational nonequilibrium in carbon dioxide; and dissipative waves due to real and artificial viscosities in a perfect gas. The two-dimensional Euler and Navier-Stokes equations are solved by using an FCT-MacCormack combined method with an operator-splitting technique and a grid generation technique. The results show features common to those three models. In the case of the regular reflection of a shock wave with a discontinuous front (shock Mach number 1.027 and wedge angle 30 deg), a short stem appears at the foot of the reflected wave and a nonstationary process occurs just after the incident wave passes over the leading edge of the wedge. Furthermore, it is shown that the wave patterns of dispersed irregular reflection can be reproduced by the present numerical simulation, as found in the experimental results. Author

A92-36356

THREE-DIMENSIONAL LOW-DENSITY FLOWS IN THE SPIRAL GROOVES OF A TURBO-MOLECULAR PUMP

K. NANBU and S. IGARASHI (Tohoku University, Sendai, Japan) (Japan-Soviet Union Joint Symposium on Computational Fluid

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Dynamics, 2nd, Tsukuba, Japan, Aug. 27-31, 1990) Computers & Fluids (ISSN 0045-7930), vol. 21, no. 2, April 1992, p. 221-228. refs

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A study to calculate the pumping performance of the spiral grooves on a rotor of a turbo-molecular pump is presented utilizing the beam-warming delta form. The 3D flow in the groove is treated as laminar, isothermal, and compressible. The computational results are compared with experimental data, and good agreement is obtained when the effects of refraction and the leak through the gap and the casing are negligibly small. It is shown that when the pressure ratio is high, a strong back flow exists near the exit of the groove. R.E.P.

A92-36829

INTERACTION OF A LONGITUDINAL VORTEX WITH A THREE-DIMENSIONAL, TURBULENT BOUNDARY LAYER

T. SHIZAWA (Tokyo, Science University, Japan) and J. K. EATON (Stanford University, CA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1180, 1181. Abridged. refs (Contract DE-FG03-86ER-13608)

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The distortion of a pressure-driven, three-dimensional boundary layer by an embedded longitudinal vortex was studied experimentally. The peak vorticity and secondary velocities were found to decay much more rapidly in a three-dimensional boundary layer than in a similar two-dimensional layer. The distortion of the boundary layer was strongly dependent on the sign of the vortex. Author

A92-37419

ANALYTICAL MECHANICS OF VISCOUS FLUID

YOSHINARI MIZUNO (Meteorological Research Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, no. 2, July 1991, p. 51-63. refs

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Formulation of analytical mechanics for viscous fluid is investigated to extend the limits of analytical mechanics to dissipative systems. A procedure to incorporate entropy with a Lagrangian function is conducted based on the principle of local thermal equilibrium. A new vector field is introduced that is the time integral of entropy flow density divided by entropy density into the Lagrangian function. R.E.P.

A92-37540

LARGE-SCALE METHOD OF LINES SOLUTION OF FLUID DYNAMIC EQUATIONS ON JAPANESE SUPERCOMPUTERS

NOBUYUKI SATOFUKA (Kyoto Institute of Technology, Matsugasaki, Japan) (Symposium on Recent Developments in Large-Scale Computational Fluid Dynamics, Minneapolis, MN, Apr. 23, 24, 1990, Technical Papers. A92-37530 15-34) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 87, no. 2-3, June 1991, p. 353-361. refs

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An approach to the numerical simulation of the fluid dynamics equations on supercomputers is proposed. The approach is based on the modified differential quadrature method and a classical fourth order explicit Runge-Kutta time integration scheme. A vorticity-stream function for 2D flow and a vorticity-vector potential function for a 3D flow are formulated to satisfy the equation of continuity. Three-dimensional instability of plane Poiseuille flow and transient turbulent flow in a plane channel is computed. O.G.

A92-38042

DO SINGULAR STRUCTURES MOVE WITH AN INVISCID FLUID?

KOJI OHKITANI (Kyoto University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 757-761. refs

(Contract MOESC-03854032)

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Beginning with the analysis of a simple case of the inviscid Burgers equation, the question is posed as to whether singular

structures move with an inviscid fluid as a fundamental characterization of general inviscid fluid motion. Formation of high vorticity-gradient regions in 2D Euler flow is studied numerically both in physical space and in the Lagrangian marker space. Each singular structure is demonstrated to be fixed in the marker space for some time, even though the vorticity gradient and the strain are not clearly separated in scale. R.E.P.

A92-38866

INFLUENCE OF INLET CONDITIONS ON THE FLOWFIELD IN A MODEL GAS TURBINE COMBUSTOR

YUJI IKEDA, YUJI YANAGISAWA, SHIGEO HOSOKAWA, and TSUYOSHI NAKAJIMA (Kobe University, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 390-400. refs

Copyright

A model combustor was designed to demonstrate the fundamental flow structure. A water model was used with a simple configuration of swirl flow and four crossflows. Velocity measurements were carried out at the swirler exit, upstream of the swirler, at the jet exits, and in the whole region of the chamber using two fiber laser Doppler velocimeters. The structure of the recirculating swirl flow was investigated in a primary zone of the model combustor. The measured results are compared with calculations based on a modified version of the k-epsilon model. The results show that the flowfield is sensitive to inlet conditions, and the position and size of the recirculation vortex formed in the primary region can be predicted satisfactorily. V.L.

A92-39336

RANDOM SWEEPING EFFECT IN ISOTROPIC NUMERICAL TURBULENCE

T. SANADA and V. SHANMUGASUNDARAM (Institute of Computational Fluid Dynamics, Tokyo, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 6, June 1992, p. 1245-1250. refs

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Results from full numerical simulations of the Navier-Stokes equations for three-dimensional, stationary, and isotropic turbulence are used (1) to study the scaling properties of two-time modal velocity correlations and (2) to determine the dominant process in the decorrelation of the small-scale velocities. The main results obtained are: (1) that the convective sweeping of the small scales by the energy-containing large scales determines the scaling property of the inertial- and near-dissipation ranges; and (2) that the sweeping effect is dominant in the decorrelation of the small scales. Reynolds-number dependence of the decorrelation is also considered. Author

A92-40057

EFFECTS OF ADVERSE PRESSURE GRADIENTS ON MEAN FLOWS AND TURBULENCE STATISTICS IN A BOUNDARY LAYER

Y. NAGANO, M. TAGAWA, and T. TSUJI (Nagoya Institute of Technology, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 2-3-1 to 2-3-6. refs

Measurements in boundary layers with 'moderate' to 'strong' adverse pressure gradients are presented and discussed. With increasing adverse pressure gradients, the velocity profile lies below the standard log law, thus indicating a reduction in the thickness of the sublayer. Correspondingly, the turbulence energy components as well as the Reynolds-shear stress peak in the outer region of the boundary layer. Higher-order moments of velocity fluctuations are also seriously affected by the adverse pressure gradient. In strong adverse-pressure-gradient flows, the triple products of velocity have opposite signs to those in zero-pressure-gradient flows over most of the boundary layer. Author

A92-40061

EFFECTS OF MULTIPLE-FREQUENCY FORCING ON SPATIALLY-GROWING MIXING LAYERS

OSAMU INOUE and SAKARI ONUMA (Tohoku University, Sendai, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 3-4-1 to 3-4-6. refs

The effect of multiple-frequency forcing on the development of a spatially-growing mixing layer is studied numerically by a two-dimensional vortex method. Forcing is prescribed as a superposition of the predominant frequency of an unforced flow with its sub-harmonic frequencies. Superposition up to three frequencies is considered. The effect of phase shift between forcing frequencies are also examined. Instantaneous plots of discrete vortices and various statistics up to the second order moment are obtained to see the variation of coherent structures. Results show that the number of merging vortices and patterns of vortex merging, and thus the growth of a mixing layer can be effectively controlled by multiple-frequency forcing if forcing frequencies and phase shifts are suitably selected. Author

A92-40064

TWO-DIMENSIONAL PATTERN RECOGNITION PROCESSING OF NEAR-WALL TURBULENCE

T. UENO and T. UTAMI (Kyoto University, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 4-2-1 to 4-2-6. refs

Two-dimensional pattern recognition processing was introduced into two-dimensional vorticity data obtained by flow visualization and picture processing. Several typical patterns of two-dimensional vorticity distribution over a small unit area were correlated with the vorticity distribution to detect the characteristic structure and arrangement of vortex motions. Ensemble averaged patterns of each velocity component and vorticity around the detected points were calculated. Author

A92-40080

PREDICTION OF THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS USING A SECOND-MOMENT CLOSURE

NOBUYUKI SHIMA (Shizuoka University, Hamamatsu, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 8-2-1 to 8-2-6. refs

A second-moment closure, which was previously validated in various two-dimensional boundary layers, is applied to three kinds of three-dimensional boundary layers. The turbulence model faithfully reproduces a fully-developed pressure-driven flow; a skewed velocity profile itself does not cause difficulties in prediction. For a shear-driven flow and a flow on a swept wing, the predictions show limited success. It is also shown that the decrease in the structure parameter is partially accounted for by the effect of 'secondary' velocity gradient terms in the stress transport equations. Author

A92-40108

TURBULENT SHEAR FLOW OVER ROWS OF TWO-DIMENSIONAL SQUARE RIBS ON GROUND PLANE

SHIKI OKAMOTO and KOUICHIROU NAKASO (Shibaura Institute of Technology, Tokyo, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 14-3-1 to 14-3-6. refs

This paper describes the detailed study of the flow structure over the rows of two-dimensional square ribs on the ground plane for various values of S/D and the optimum value of S/D to augment the turbulence of the free stream. The pitch between the centers of two adjoining square ribs was varied at $S/D = 2, 3, 4, 5, 7, 9, 13$ and 17 . The time-mean velocity and the velocity vectors were measured by the pitot- and static pressure tubes, and the cylindrical yawmeter of 6 mm diameter having three pressure holes. The

turbulence intensities, auto-correlation and power spectrum were obtained using the data processing system and the F.F.T. analyzer connected to the hot wire anemometer. As a result it is concluded that the pitch ratio $S/D = 9$ is optimum to augment the turbulence intensity. Author

A92-40110

INSTABILITY OF FLOW PAST AN ISOLATED ROUGHNESS ELEMENT IN THE BOUNDARY LAYER

K. ONO (Nihon University, Tokyo, Japan), T. TAMURA (Shimizu Corp., Ohsaki Research Institute, Tokyo, Japan), K. KUWAHARA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and T. MOTOHASHI (Nihon University, Funabashi, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 14-5-1 to 14-5-6. refs

Results of experimental and computation studies investigating the flowfield around an isolated roughness element (a circular cylinder) are presented. The roughness element is totally submerged in the laminar boundary layer of the flat plate in order to elucidate the transition process of the wake to the turbulence. The structure and the instability of the wake near the cylinder are examined. A newly developed return-type wind tunnel is used to measure the velocity field, using a hot-wire anemometer. The 3D Navier-Stokes equations with a body-fitted coordinate system are also solved by the finite difference method. The computational results show the formation and development of the horseshoe vortex and the arch vortex. In addition to the arch vortex, longitudinal twin vortices are found to be formed just downstream of the circular cylinder. These vortices explain the characteristics of the experimental results. C.A.B.

A92-40122

AN EXPERIMENTAL STUDY ON THE SEPARATION OF A TURBULENT BOUNDARY LAYER FROM A SHARP EDGE

SHINTARO YAMASHITA (Gifu University, Japan), IKUO NAKAMURA, TAKEHIRO KUSHIDA (Nagoya University, Japan), and HIROYA YAMADA (Daido Institute of Technology, Nagoya, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 17-4-1 to 17-4-6. refs

Results of the measurement of flow properties in the shear layer occurring when a fully developed two-dimensional turbulent boundary layer separates from a sharp edge of a groove are presented, especially focusing on the region near the edge. The effect of the edge on the boundary layer extends slightly upstream of the edge. The mean and fluctuating velocities and Reynolds stress change significantly in the longitudinal direction. The turbulent energy production and dissipation are in a state of extreme disequilibrium in the inner mixing layer just behind the edge. The turbulent energy spectrum in the mixing layer has a fold or a peak, suggesting the existence of a coherent structure. Author

A92-40145

THERMALLY DRIVEN TURBULENT BOUNDARY LAYER

T. TSUJI, Y. NAGANO, and M. TAGAWA (Nagoya Institute of Technology, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 24-3-1 to 24-3-6. refs

The budgets of turbulent energy, Reynolds shear stress, mean square scalar variance and turbulent heat fluxes have been evaluated in a thermally driven boundary layer in air along a vertical flat plate. In the near-wall region, the velocity-gradient correlation plays an important role in turbulent energy production and thermal energy is directly converted into kinetic energy through this correlation. Consequently, Reynolds shear stress and streamwise turbulent heat flux near the wall, which are normally considered to have close relations with the energy production process, behave differently from those in the ordinary turbulent boundary layers.

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On the other hand, the energy transfer in the outer region of the boundary layer becomes a process similar to that observed in the usual boundary layer. Author

A92-40147

HEAT TRANSFER IN A TURBULENT BOUNDARY LAYER WITH AN INSERTION OF A LEBU PLATE

K. SUZUKI, H. SUZUKI, K. INAOKA, and H. KIGAWA (Kyoto University, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 24-5-1 to 24-5-6. refs

An experimental study was performed for a turbulent boundary layer disturbed by an insertion of the LEBU (Large Eddy Break-up) plate. Skin-friction coefficient, heat transfer coefficient, and averaged and fluctuating components of streamwise and cross-stream velocities were measured. Quadrant analysis was applied to the measured fluctuating velocity signals. Although the dissimilarity between the momentum transfer and heat transfer was conspicuous in a turbulent boundary layer disturbed by a cylinder, it is not so strong in the present type of disturbed boundary layer. The difference between the two cases is discussed in terms of the results of the applied quadrant analysis. Author

A92-40150

A CIRCULAR JET INJECTED INTO THE WAKE OF A CIRCULAR CYLINDER SET IN A UNIFORM FLOW

HIROYA YAMADA (Daido Institute of Technology, Nagoya, Japan), IKUO NAKAMURA (Nagoya University, Japan), SHINTARO YAMASHITA (Gifu University, Japan), and HARUHISA YANO (Daido Institute of Technology, Nagoya, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 25-3-1 to 25-3-6. refs

An experimental study has been performed on the three-dimensional mixing process in the turbulent jet which was injected into a quiescent fluid as well as into the wake of the cylinder from a circular hole made on the circular cylinder. Even in the case of an injection into quiescent fluid, the flow field exhibits asymmetrical spread, and secondary flow. In the case of the injection into the wake, the asymmetrical spread becomes rather remarkable, and the secondary flow becomes even stronger than with injection into quiescent fluid. Although the decay of the relative maximum velocity in relation to the wake differs according to the injection velocity ratio, it decays in proportion to about $x^{-(2/3)}$. The turbulence intensity of the wake becomes lower by injection of the jet. Author

A92-40154

MODELING PRANDTL NUMBER INFLUENCE ON TURBULENT SCALAR FLUX

N. SHIKAZONO and N. KASAGI (Tokyo, University, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 27-2-1 to 27-2-6. refs (Contract MOESC-01460116)

In the present study, low Peclet number effects are studied in modeling the pressure-scalar gradient correlation and dissipation terms in the transport equation of the turbulent scalar flux. With the aid of direct numerical simulation (DNS) data bases, it is demonstrated that both terms have dominant roles in the transport equation and should be modeled separately, especially in low Peclet number flows. The anisotropy of these terms are well aligned with that of scalar flux. These relations are then used in deriving a new model. It is shown that the present model gives fairly accurate predictions for the scalar flux in isotropic turbulence and 2D turbulent channel flows of different Prandtl number fluids. Author

A92-40160

TURBULENCE MODEL FOR THE DISSIPATION COMPONENTS OF REYNOLDS STRESSES

M. TAGAWA, Y. NAGANO, and T. TSUJI (Nagoya Institute of Technology, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 29-3-1 to 29-3-6. refs (Contract MOESC-01613002)

This paper develops a model for the nonisotropic dissipation rate tensor DRT to close the Reynolds-stress transport equations. Recent direct-simulation data of the turbulent boundary layer and channel flows reveal the strongly nonisotropic nature of the dissipation process, which differs considerably from that of the Reynolds-stress components. The present model provides nonisotropic dissipation-rate components through the solutions of approximated transport equations for DRT, and hence, the conventional prescription of an ad hoc value of DRT is not needed. The proposed model is tested by direct comparisons with the reported full simulation data to validate the performance of the model predictions. Author

A92-41052

A STUDY ON VELOCITY PROFILES OF DEVELOPING LAMINAR OSCILLATORY FLOWS IN A SQUARE DUCT

MANABU IGUCHI (Osaka University, Suita, Japan), GIL-MOON PARK (Chosun University, Kwangju, Republic of Korea), FUJIO AKAO (Kure Technical College, Japan), and FUJIO YAMAMOTO (Fukui University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 158-164. refs Copyright

Oscillatory laminar flow near the entrance of a rectangular duct is considered, and an entrance length of the flow is defined as the maximum axial migration distance of fluid particles from the duct entrance. Analytical solutions were derived for two subregions, where only a linearized axial equation of motion could be applied. An analytical solution for each subregion was compared with the velocity profiles measured by a hot-wire anemometer and close agreement was found between them. O.G.

A92-41053

RENORMALIZATION GROUP ANALYSES OF K-EPSILON MODEL AND LES MODEL OF TURBULENCE PROBLEM

WAKO TAKANASHI (Shimizu Corp., Civil Engineering Div., Tokyo, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 186-188. refs Copyright

Renormalization group analysis for the turbulence problem is presented. This procedure does not require any experimentally adjustable parameters. Numerical values for relevant constants of turbulent flow can be derived, e.g., the Kolmogorov constant, 1.605, for the inertial-range spectrum and the turbulent Prandtl number, 0.7179, for high-Reynolds-number heat transfer. A differential turbulence (k-epsilon) model is derived in the high-Reynolds-number regions of flow with the algebraic relation $\nu = 0.0846 k\text{-squared}/\epsilon$. A differential large eddy simulation model is also derived, as is the Smagorinsky constant, 0.00615. Author

A92-41054

INITIAL STAGE OF A THREE-DIMENSIONAL VORTEX STRUCTURE EXISTING IN A TWO-DIMENSIONAL BOUNDARY LAYER SEPARATION FLOW - OBSERVATION OF LAMINAR BOUNDARY LAYER SEPARATION OVER A CIRCULAR CYLINDER BY FLOW VISUALIZATION

YOSHIFUMI YOKOI and KYOJI KAMEMOTO (Yokohama National University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 189-195. refs Copyright

A92-41055

STUDIES ON OPPOSED TURBULENT JETS - IMPACT POSITION AND TURBULENT COMPONENT IN JET CENTER

NOBUO OGAWA, HIROSHI MAKI (Tokyo, Science University, Noda, Japan), and KUNIO HIJIKATA (Tokyo Institute of Technology, Japan) JSME International Journal, Series II (ISSN 0914-8817),

vol. 35, no. 2, May 1992, p. 205-211. refs
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The effect of fluctuating velocity variations on the impact position is considered, and the mechanism fixing the impact position at a certain position is quantitatively clarified through the use of various turbulent flowfields generated by grids in the opposed nozzles. Results revealed that the impact position moved to the side with increased x-direction turbulence in the jet center under the condition that both opposed jets had the same mean velocity. It is shown that double impact positions can sometimes be seen when strong turbulence is generated by a grid set in one side of the nozzle in turbulent opposed jets. O.G.

A92-41056
DENSITY MEASUREMENTS OF UNDEREXPANDED FREE JETS OF AIR FROM CIRCULAR AND SQUARE NOZZLES BY MEANS OF MOIRE-SCHLIEREN METHOD

KATSU'INE Tabei, HIROYUKI SHIRAI, and FUMIO TAKAKUSAGI (Gumma University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 212-217. refs
(Contract MOESC-01550135; MOESC-63302022)
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Using the moire-schlieren method for symmetric and asymmetric flowfields, density distributions of underexpanded free jets of air from circular square nozzles have been measured. Experimental moire image data of the flows, which show integrated light deflection across the flow, were converted to an internal density distribution by the numerical inverting method. The experiment was performed systematically by changing the pressure ratio across the nozzles from 4 to 13. It was found that the density profiles measured in the expanded free jets from a circular nozzle agreed well with other experimental results, and that those for a square nozzle were much more complex than for a circular nozzle. In spite of the large difference in such profiles, the density variations along the flow axis for both nozzles were very similar to each other. Author

A92-41057
STABILITY OF CONVERGING CYLINDRICAL SHOCK WAVES
MASATO WATANABE and KAZUYOSHI TAKAYAMA (Tohoku University, Sendai, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 218-227. refs
Copyright

A study aimed at clarifying the nature of instability in converging cylindrical shock waves is presented. It is concluded that holographic interferometry is particularly useful for observing the early onset of instability in the flowfield of a collapsing cylindrical shock wave preceding its transformation from a single wave to a deformed multiple wave. Initial small perturbations of the shock wave grow with shock propagation and cause the formation of triple points. The greater the severity of the initial disturbance and the smaller the mode number, the larger is the amplification of the shock wave distortion. O.G.

A92-41058
EFFECTS OF SPLITTER BLADES ON THE FLOWS AND CHARACTERISTICS IN CENTRIFUGAL IMPELLERS
HIROYUKI MIYAMOTO (Yatsushiro National College of Technology, Japan), YUKITOSHI NAKASHIMA, and HIDEKI OHBA (Kyusyu-Tokai University, Kumamoto, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 238-246. refs
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A five-flow pressure probe was used to perform flow measurements in an unshrouded impeller and in a shrouded impeller with splitter blades. The effect of the splitter blade on passage flow and impeller performance was analyzed by comparing the results with those of impellers without splitter blades. It is found that, in impellers with splitter blades, the blade loadings tend to become smaller, and the absolute circumferential velocities and total pressures become considerably larger than those in impellers without splitter blades. It is noted that the splitter blade

effect on static pressure differs between the unshrouded and shrouded impellers. O.G.

A92-41060
OBSERVATIONAL STUDY OF POOL BOILING UNDER MICROGRAVITY

TOSHIHARU OKA (Keio University, Yokohama, Japan), YOSHIYUKI ABE, KOTARO TANAKA (Electrotechnical Laboratory, Tsukuba, Japan), YASUHIKO H. MORI, and AKIRA NAGASHIMA (Keio University, Yokohama, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 2, May 1992, p. 280-286. refs
Copyright

Pool boiling experiments under microgravity were conducted, utilizing parabolic flight maneuvers with a CNES Caravelle 6R aircraft. The experimental apparatus taken aboard the aircraft was constructed to enable simultaneous recording, by a video camera, of the side view of vapor bubbles generated on Joule-heated titanium foil immersed in a pool of n-pentane liquid, and the color pattern exhibited by a liquid-crystal layer, which was plated on the backside of the foil. This apparatus successfully recorded observations of behaviors of vapor bubbles, at various liquid subcoolings (7-32 K) and heat fluxes (1.1-42 kW/sq m), and spatial color variation of the crystal layer, possibly reflecting microlayer dynamics beneath the individual bubbles. In spite of the great difference in size and population of the bubbles, between microgravity and terrestrial conditions, no more than a moderate difference was found in overall heat transfer between the two conditions. Author

A92-41362
CONVECTION IN A DIFFERENTIALLY-HEATED SQUARE CAVITY WITH A TORSIONALLY-OSCILLATING LID

REIMA IWATSU (Institute of Computational Fluid Dynamics, Tokyo, Japan), JAE M. HYUN (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea), and KUNIO KUWAHARA (Institute of Space and Astronautical Science, Sagami-hara, Japan) International Journal of Heat and Mass Transfer (ISSN 0017-9310), vol. 35, no. 5, May 1992, p. 1069-1076. refs
Copyright

Numerical studies are made of the flow of a viscous thermally-stratified fluid in a square container. The flow is driven by the top lid of the container, which executes torsional oscillations. A stabilizing vertical temperature difference ($T_{\text{sub H}} - T_{\text{sub C}}$) is applied on the horizontal boundary walls; the two vertical side walls are thermally insulated. Numerical solutions are secured to the time-dependent Navier-Stokes equations under the Boussinesq-fluid approximation. Details of unsteady flow and thermal fields are exhibited over broad ranges of three principal parameters, i.e., the Reynolds number, the Grashof number, and the frequency ratio. Of particular interest is the possibility of resonance; this gives rise to intensification of flows in the interior and associated augmentation of convective heat transport. Systematically-organized computational results indicate that the existence of resonance is verified, and the enhancement of heat transfer is demonstrated at particular values of the frequency ratio. Author

A92-41829
NUMERICAL SIMULATION OF TWO-DIMENSIONAL REACTING MIXING LAYER

XIAO WANG and TOSHI FUJIWARA (Nagoya University, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, no. 106, Feb. 1992, p. 197-211. refs

A direct numerical simulation is performed on a temporally-forced 2D reacting mixing layer. The chemical reaction considered in the present study is a binary, single-step, irreversible one with no heat release, and the assumptions of both diffusion-controlled and finite-rate models are utilized under moderate Reynolds numbers. The results are obtained at different Reynolds, Peclet, and Damkohler numbers to appreciate their effects on the mixing layer and diffusive flame: mixing of reactants is reinforced and flame sheet is distorted severely by convective

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entrainment with the increase of Reynolds number; low Peclet number implies high rate of species diffusion, which causes low gradient of product concentration and thick reacting strip; the product concentration pattern is insensitive to Damkohler number, while the product formation rate is strongly dependent on it; the process of formation and extinguishment of flame island are demonstrated. Author

A92-41830

STATIC MENISCUS CONFIGURATIONS IN AXISYMMETRIC CONTAINERS UNDER LOW-GRAVITY CONDITIONS

TSUKASA NAKAYAMA (Chuo University, Tokyo, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, no. 106, Feb. 1992, p. 212-225. refs

The static configuration of an equilibrium interface between a liquid and a gas under low-gravity conditions has been investigated numerically. The Young-Laplace equation which governs the interfacial shape is transformed into a system of four ordinary differential equations and solved by the Runge-Kutta method under initial conditions and a contact-angle condition. Equilibrium shapes of interfaces are computed in 2D rectangular, 3D circular cylindrical and spheroidal containers, and the numerical results are compared with available analytical solutions. Good agreement has been obtained. Author

A92-42797

FLOW AROUND TWO SQUARE CYLINDERS IN STAGGERED ARRANGEMENTS

KAZUHITO FUJIWARA, HIDEO MATSUO, KENJI ONO, and TETSUYUKI HIROE Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 276-284. In Japanese. refs

Flow around two square cylinders is investigated by the measurement of the surface pressure, the flow visualization, and the supplementary numerical simulation. Two different types of flow patterns are observed which are characteristic of staggered arrangements. In either case, the gap flow is formed between two cylinders, which is biased toward the upstream cylinder. The biased flow then undergoes two different changes in the subsequent period, depending on the relative location of cylinders. In the first case, it flows on straightforward and finally builds up a strong vortex behind the upstream cylinder. In the second case, it changes the direction and deviates toward the downstream cylinder. A strong vortex is now built up behind the downstream cylinder. However, the second flow is not stable and can not exist by itself. The fluctuation between the first and the second flows always appears in this case. The transition between the two flow regimes is abrupt under the continuous change in the cylinder arrangement. Author

A92-44532

VELOCITY PROFILE OF A BOUNDARY JET IN A ROTATING FLUID

IWAO YAMASHITA (Ariake National College of Technology, Ohmuta, Japan) and MASAKI TAKEMATSU (Kyushu University, Kasuga, Japan) Kyushu University, Research Institute for Applied Mechanics, Reports (ISSN 0023-6195), vol. 38, no. 109, Feb. 1992, p. 85-91. refs

A laminar boundary jet adjacent to a vertical sidewall of a rotating circular cylinder was studied experimentally. The boundary jet was produced by differential rotation of a ring-shaped plate along the periphery of the top surface of the working fluid. The velocity field of the resulting boundary jet was observed by a pH-indicator method with special interest in the case when the width of the driving ring was $O(E \exp 1/4)$ (E is the Ekman number). It was demonstrated that the azimuthal velocity has an appreciable vertical shear and that the vertical velocity in the boundary jet is of order $E \exp 1/4$. The vertically averaged azimuthal velocity profile was compared with an empirical formula which is a modified version of the theoretical solution given by Kimura (1976). Author

A92-45415

STATIC CHARACTERISTICS OF A TWO-PHASE FLUID LOOP SYSTEM

K. KAWAMOTO, K. FURUHAMA, K. MIMURA, Y. MIYAZAKI (Toshiba Corp., Tokyo, Japan), M. FURUKAWA, and Y. ISHII (NASDA, Tokyo, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 451-460. refs (SAE PAPER 912023) Copyright

The Two-Phase Fluid Loop (TPFL) system is a heat transport system for future large spacecraft, using latent heat of coolant. A ground test facility was developed capable of dissipating a 5 kW heat load, and the components of that facility were tested. As a next phase, static characteristics of the TPFL system are being studied. In this paper, static behaviors under heat load variation are presented as results of the experimental study and the numerical simulation. For the experimental study, the above-mentioned ground test facility was used. In this facility, heat is finally dissipated to the heat exchanger using brine as a heat sink. In order to determine static behaviors for an actual radiator heat-rejection system used in orbit, numerical simulation was carried out. To confirm the analytical model used in the numerical simulation, the numerical result and the experimental result were compared. Author

A92-45416

DEMONSTRATION OF GAS LIQUID SEPARATION UNDER THE MICROGRAVITY BY AIRCRAFT KC-135

OSAMU MURAGISHI and SEIJI NISHIO (Kawasaki Heavy Industries, Ltd., Gifu Technical Institute, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 461-470. (SAE PAPER 912024) Copyright

Verification of liquid-gas separation function of the functional tank under high-gravity by pull-up and under microgravity by parabolic flight was conducted aboard a KC-135. Video recording of liquid behavior under microgravity in the tanks that have partial structures of surface tension tank inside was performed. Experimental results with photo data, acceleration data, etc. are presented. R.E.P.

A92-45444

MONTE CARLO DIRECT SIMULATION OF AXISYMMETRIC RAREFIED GAS FLOWS THROUGH THRUSTER NOZZLES FOR SPACECRAFTS

MASAHIRO OTA and TETSUYA TANAKA (Tokyo Metropolitan University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 759-765. refs (SAE PAPER 912062) Copyright

Axial symmetric flows of a monoatomic rarefied gas exhausted through the thruster nozzle of an artificial satellite were numerically simulated by Direct Simulation Monte Carlo method, since the transitional flow regime occurs at altitudes where the enhancement region is several orders of magnitude larger than the nozzle throat diameter of the thruster (high altitude rocket). On macroscopic flows in the nozzle at the orifice, the effects of Knudsen numbers are revealed. At lower Knudsen number regions, the flows are more accelerated by the effects of intermolecular collisions. On the inside surface of the nozzle, macroscopic velocity and temperature distributions are built up in the radial direction. At lower Knudsen number regions, the thickness of these boundary layers are getting thinner. Author

A92-45577#

COMPARISON OF NUMERICAL SOLUTIONS OF PSEUDOCOMPRESSIBLE FLOWS AND COMPRESSIBLE FLOWS AT LOW MACH NUMBERS

KOJI MORINISHI (Kyoto Institute of Technology, Japan) AIAA,

Applied Aerodynamics Conference, 10th, Palo Alto, CA, June 22-24, 1992. 12 p. refs
(AIAA PAPER 92-2648) Copyright

Numerical solutions for pseudocompressible flows and compressible flows at low Mach numbers are obtained as substitutional solutions for incompressible flows. The governing equations are spatially discretized by central finite-difference approximations. The rational Runge-Kutta scheme is used for the time stepping scheme. The characteristic time stepping, implicit residual averaging, and multigrid techniques are used to accelerate the convergence rate of the scheme to the steady state solution. The direct comparisons are made between the pressure distributions of the pseudocompressible flow results and those of the compressible flow results. As typical test flow problems, a square driven cavity flow, a laminar flow inside a two-dimensional channel with a 90 deg bend, and a laminar flow inside a square duct with a 90 deg bend are considered. The effects of mesh refinement and artificial dissipation models upon the values of loss coefficient predicted for the channel flow are examined.

Author

A92-46975 STUDY ON THE NATURE OF TURBULENT INTERMITTENCY IN A COFLOWING TURBULENT FREE JET

TORU KOSO and HIROSHI HAYAMI Kyushu University, Institute of Advanced Material Study, Reports (ISSN 0914-3793), vol. 5, no. 2, 1991, p. 175-188. In Japanese. refs

Study on the structure and dynamics of turbulent intermittency which has been carried out in the laboratory is reviewed. Turbulent intermittency functions were derived from hot-wire signals using a turbulent/nonturbulent decision processing, and used to obtain the zone average velocity and spectrum of intermittency. Walsh spectral analysis reveals that the large scale motions have many length scales longer than several-times the velocity half width. By using a 7-channel hot-wire array, conditional ensemble averaged patterns of turbulent bulges were assessed. An interesting phenomenon that the tip of turbulent bulge flowed slower than the coflowing free stream is attributed to the large-scale eddy motions in the intermittent region. A novel method to measure the conditional turbulent zone average by using laser Doppler anemometer with selective seeding was developed and compared experimentally with the method based on hot-wire signals.

Author

A92-47098 NUMERICAL STUDIES ON A REACTING MIXING LAYER WITH CHEMICAL HEAT RELEASE

XIAO WANG and TOSHI FUJIWARA (Nagoya University, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 35, no. 107, May 1992, p. 1-13. refs

A numerical simulation of a nonpremixed, temporally-developing reacting mixing layer is performed by solving the time-dependent, compressible Navier-Stokes and species conservation equations. The chemical reaction is based on a binary, one-step, irreversible model. Diffusive properties are considered to be temperature-dependent. The conservation equations are integrated by means of finite difference method and the utilized numerical algorithm is MackCormack second-order explicit predictor-corrector method. The results are obtained at different heat release parameters, showing, in qualitative agreement with the previous studies, that heat release has effects of suppressing the growth rate of hydrodynamic instability, smearing and diffusing both the vortical and reactive-zone large-scale structures, and reducing product formation. In general, with the increase of diffusivities, hydrodynamic instabilities are reduced as indicated by quick saturation of rollup and pairing processes and reduction of vorticity strength; reactive-zone structures become diffusive and product formation is enhanced by a small amount, relative to the corresponding case of constant diffusivities.

Author

A92-47401 COHERENT STRUCTURE OF A D-TYPE ROUGH WALL BOUNDARY LAYER IN A FULLY ROUGH REGIME (RESULTS WITH THE FOUR-QUADRANT ANALYSIS)

SHINSUKE MOCHIZUKI and HIDEO OSAKA Yamaguchi University, Faculty of Engineering, Memoirs (ISSN 0372-7661), vol. 42, no. 2, March 1992, p. 1-8. In Japanese. refs

Coherent structure of a d-type rough wall boundary layer at a fully rough regime has been investigated with the four-quadrant analysis. Fractional stress contribution of the events associated with the bursting phenomenon was quantitatively analyzed and compared with the results at a low Reynolds number. The fractional stress contribution of the second quadrant (ejection event) decreases with increasing Reynolds number. The contribution of the violent events was studied and the significant difference of the turbulent structure among d-type rough, k-type rough and smooth wall flows was found.

Author

A92-47867# THE EXPERIMENTAL STUDY ON HEAT REJECTION EQUIPMENT

TOSHIHIKO NAKAGAWA, MASAHIRO ATSUMI (Mitsubishi Heavy Industries, Ltd., Nagoya, Japan), and RINZO TOKUE (Sumitomo Precision Products Co., Ltd., Amagasaki, Japan) AIAA, Thermophysics Conference, 27th, Nashville, TN, July 6-8, 1992. 10 p. Research supported by NASDA. refs
(AIAA PAPER 92-2889) Copyright

This paper describes the concept study and the experimental work for development of the advanced style expendable heat rejection device. Emphasis is laid on minimizing the hardware weight and using innocuous coolant. Empirical heat transfer characteristics of water spray cooling were obtained and applied to the mathematical model to evaluate the performance. Besides the development of spray nozzle, prototype model of 4 kW class evaporator was fabricated and tested. Heat rejection rate of 3.2-4.5 kW was attained at both (high/low altitude) modes of operation, and feasibility of this heat rejection device was assured.

Author

A92-48255 TRANSITION BETWEEN WEAK AND STRONG TURBULENCE OBSERVED IN COMPLEX GINZBURG-LANDAU EQUATION WITH A QUINTIC NONLINEARITY

SADAYOSHI TOH and HIROSHI IWASAKI (Kyoto University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1495-1504. refs
(Contract MOESC-03740200) Copyright

The 1D complex Ginzburg-Landau equation with a quintic nonlinearity is studied here in order to confirm the possibility of the transition between weak and strong turbulence and between soft and hard turbulence. The characteristics of asymptotic states are also examined. Three types of turbulent states are observed as dissipative effects decrease. The first state is a weak chaos driven by modulational instability, the second is a turbulent state characterized by the occurrence of relatively small bursts, and the third is a strongly intermittent turbulence dominated by bursts which blow up and get close to a singular solution of the 1D nonlinear Schroedinger equation until dissipation starts to take effect.

C.D.

A92-48999# STUDY OF COMPRESSIBILITY EFFECTS OF THREE-DIMENSIONAL MIXING LAYER BY NUMERICAL SIMULATION

ITARU HATAUE (Kyoto University, Japan) and HIDEO TAKAMI (Kanagawa University, Hiratsuka, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 6 p. refs
(AIAA PAPER 92-3442) Copyright

The objective of this paper is to study numerically the mixing layer between two parallel high speed streams for various Mach numbers. Harten type second order TVD (Total Variation Diminishing) scheme and LU-ADI efficient implicit scheme are applied in order to solve the three-dimensional compressible Navier-Stokes equations without using any turbulence model. The compressibility effects in the compressible mixing layer are discussed on the basis of the simultaneously obtained statistics.

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The computed results show that the vorticity fields fluctuate unsteadily in the spanwise direction and three-dimensionality becomes prominent in the case of high Mach number. Author

A92-49457

OBSERVATION OF FINE STRUCTURES IN THE KURAMOTO-SIVASHINSKY TURBULENCE

H. MIURA and Y. AIZAWA (Waseda University, Tokyo, Japan) *Chaos, Solitons & Fractals* (ISSN 0960-0779), vol. 2, no. 1, Jan.-Feb. 1992, p. 73-79. refs

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Turbulence in the KS equation is numerically studied by use of the level-crossing technique. The soliton-like excitation and the more detailed structure embedded in the KS turbulence are elucidated by the symbolic coding method and by the return map reconstruction. New scaling aspects of the KS turbulence are discovered. Author

A92-50569

DEVELOPMENT OF ADVANCED SPACE SOLAR DYNAMIC RECEIVER

YOSHIYUKI ABE, KOTARO TANAKA, OSAMI NOMURA, KATSUHIKO KANARI, YOSHIO TAKAHASHI, and MASAYUKI KAMIMOTO (Electrotechnical Laboratory, Tsukuba, Japan) IN: *IECEC '91: Proceedings of the 26th Intersociety Energy Conversion Engineering Conference*, Boston, MA, Aug. 4-9, 1991. Vol. 1. La Grange Park, IL, American Nuclear Society, 1991, p. 291-296. refs

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Work on an advanced solar dynamic receiver is reviewed. The authors first describe the component test of the receiver tube with LiF in metallic containers, which was performed in a closed high-temperature He-Xe loop. They then give the details of the development of composite phase change materials, such as ceramic/molten salts or carbon/molten salts for advanced receiver concepts. As for SiC/LiF composites, the performance test of the receiver component will soon be ready to begin. I.E.

A92-52047

LARGE EDDY SIMULATION OF BACKWARD-FACING STEP FLOW

TOSHIO KOBAYASHI (Tokyo, University, Japan), YUHEI MORINISHI (Nagoya Institute of Technology, Japan), and KEON-JE OH (Kyungnam University, Masan, Republic of Korea) *Communications in Applied Numerical Methods* (ISSN 0748-8025), vol. 8, no. 7, July 1992, p. 431-441. refs

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Recirculating flow around a backward-facing step is calculated by large eddy simulation (LES). The reattachment length is found to be $x(R)/H = 8$ for a Smagorinsky constant of $C = 0.15$, and $x(R)/H = 9$ for $C = 0.10$. In the recirculating region, three eddy structures can be observed in the instantaneous streamline distributions, and the location of the reattachment point varies according to the size of these eddies. The streamwise turbulence intensities at the start of the recirculating region around the step are considerably reduced by LES in comparison with the values predicted by the k-epsilon model, but they have somewhat higher values than those of the k-epsilon model as it approaches the reattachment point. Author

A92-52362

ON THE PERFORMANCE OF ADAPTIVE MESH REFINEMENT COMPUTATION

N. UCHIYAMA and O. INOUE (Tohoku University, Sendai, Japan) *Shock Waves* (ISSN 0938-1287), vol. 2, no. 2, 1992, p. 117-120. refs

Copyright

A finite difference scheme for the unsteady Euler equations using an adaptive mesh refinement (AMR) algorithm was applied to the time-dependent flowfield of shock diffraction problems. The effectiveness of the AMR algorithm was evaluated against a uniform mesh algorithm. Computational results showed that to obtain

solutions with equivalent resolution, the AMR algorithm requires much less processing time, when compared with a uniform mesh algorithm. Author

A92-52641

OVERLOOKED FACTORS AND UNSOLVED PROBLEMS IN EXPERIMENTAL RESEARCH ON CONDENSATION HEAT TRANSFER

TETSU FUJII (Kyushu University, Kasuga, Japan) *Experimental Thermal and Fluid Science* (ISSN 0894-1777), vol. 5, no. 5, Sept. 1992, p. 652-663. refs

Copyright

Some overlooked factors and unsolved problems in classical experimental studies on condensation are explained in connection with the comparison between experimental results and corresponding theories, for example, the effect of local variation of tube surface temperature on the correlation equation of the Nusselt number, the occurrence of tube wall temperature fluctuation in the transition region of coolant flow, the necessity of selecting appropriate experimental data and the use of accurate physical property data, the features of binary mixture condensates and microscopic observation of them, the stratification of concentration and temperature in binary vapor mixtures, the difference between the heat transfer enhancement effect of fins with a single tube and tube bundles, the effect of the accuracy of the thermodynamic equation of state on the correlation between the mass transfer coefficient at the vapor-liquid interface and the vapor velocity in the case of binary mixtures. Author

A92-52716

KINETIC MODEL APPROACH TO THE SHOCK STRUCTURE PROBLEM - A DETAILED ASPECT

H. HONMA, D. Q. XU (Chiba University, Japan), and H. OGUCHI (Lasertec Laboratory, Tokyo, Japan) IN: *Rarefied gas dynamics; Proceedings of the 17th International Symposium*, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 161-166. refs

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For a plane shock structure problem, the kinetic model analysis is worked out with special attention focused on the applicability of the kinetic model analysis and the behavior of asymmetric nature in shock profile over very weak shock region close to the Mach number unity. As the result, the applicability of kinetic model analysis, not only qualitatively but also quantitatively, is assured for the shock structure from comparison of the existing data. The behavior of asymmetric nature in shock profile over very weak shock region indicates that the kinetic-model data is closer to the Burnett solution than the Navier-Stokes solution, as the Mach number tends to unity, within the limit of the present computation. Author

A92-52717

SHOCK WAVE STRUCTURES IN A BINARY GAS MIXTURE WITH LARGE MOLECULAR MASS RATIO

YOSHIMOTO ONISHI, SYOZO KUBO (Tottori University, Japan), and HIROYUKI MIURA (Kinki University, Higashiosaka, Japan) IN: *Rarefied gas dynamics; Proceedings of the 17th International Symposium*, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 167-174. refs

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Shock wave structures of a binary mixture of inert monatomic gases are investigated on the basis of the Boltzmann equation of BGK type. By a finite difference method, the equation has been solved numerically for the structures of a binary gas mixture with large molecular mass ratio when the concentration of the heavier component gas is small but its mass concentration is of the order of unity or less. Actual calculations have been carried out for shock waves with relatively large Mach numbers in the case of He-Ar and He-Xe mixtures. Particular attention has been paid to the following phenomena associated with the differences of the relaxational processes occurring within the shock: (1) the overshoot

in the heavy gas temperature, and (2) the double hump structure in the light gas number density predicted experimentally by Polish scientists. Author

A92-52723

NUMERICAL ANALYSIS OF UNSTEADY MOTION OF A RAREFIED GAS CAUSED BY SUDDEN CHANGES OF WALL TEMPERATURE WITH SPECIAL INTEREST IN THE PROPAGATION OF A DISCONTINUITY IN THE VELOCITY DISTRIBUTION FUNCTION

KAZUO AOKI, YOSHIO SONE, KENJI NISHINO, and HIROSHI SUGIMOTO (Kyoto University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 222-231. refs
Copyright

An unsteady gas motion induced in a semi-infinite expanse of a rarefied gas by sudden heating (or cooling) of the plane wall bounding the gas is analyzed numerically on the basis of the Boltzmann-Krook-Welander equation and the diffuse reflection. The time development of the disturbance in the gas is pursued, for various cases of heating and cooling, over a long time from the initial moment when the heating or cooling occurs. In particular, the propagation and attenuation of the discontinuity in the velocity distribution function are analyzed accurately. Author

A92-52747

ANALYTICAL AND NUMERICAL STUDIES OF RAREFIED GAS FLOWS ON THE BASIS OF THE BOLTZMANN EQUATION FOR HARD-SPHERE MOLECULES

YOSHIO SONE (Kyoto University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 489-504. refs
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The relation between the hydrodynamic system and the Boltzmann system in the boundary-value problem of a steady flow with small Knudsen numbers is first reviewed with emphasis on recent developments, including the general feature of the force and its moment on a closed body in the gas as well as the Knudsen-layer analysis of a hard-sphere molecular gas. Secondly, various fundamental rarefied gas flows, analyzed for the whole range of the Knudsen number on the basis of the Boltzmann equation for hard-sphere molecules by the methods developed in the Knudsen-layer analysis, are summarized. Author

A92-52763

RAREFIED GAS NUMERICAL WIND TUNNEL

KATSUHISA KOURA (National Aerospace Laboratory, Chofu, Japan), EMI KANEMATSU, and YUKIKO KIMURA (Fujitsu, Ltd., Tokyo, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 663-670. refs
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The 'rarefied gas numerical wind tunnel' (RGNWT) is constructed using the null-collision (NC) direct-simulation Monte Carlo (DSMC) method for the simulation of rarefied gas flows around a two- or three-dimensional whole flight body. The NC-DSMC method is efficient in the simulation of 2D or 3D flows, because its lower limit of the mean molecular number per collision cell is as small as one and its computation time is comparable with that for the time-counter DSMC method. The computation domain, collision, and data cells are taken as rectangular solids. In the present paper, the RGNWT results without real gas effects are presented for a 2D circular cylinder and a 3D flat-plate delta wing at a large angle of attack. The effects of the collision-cell size, time step, and molecular number per data cell on RGNWT results are investigated for the circular cylinder. Author

A92-52765

MONTE CARLO DIRECT SIMULATION OF HEAT TRANSFER THROUGH A RAREFIED GAS

MASARU USAMI, HAJIME KYOGOKU, and SEIZO KATO (Mie University, Tsu, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 687-694. refs
(Contract MOESC-64550134)
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Three aspects of the Monte Carlo direct simulation (MCDS), which are indispensable for the realization of the simulation with a complicated large flow field of a near-continuum flow, are considered. These are: a weighting factor for time scale, a neural net used to connect grid cells and to form a macrocell network, and a process of parallel processing by transputers. An optimization problem using the neural net is solved showing that the neural net is a promising method for dividing the physical space into cells in the MCDS. I.S.

A92-52803

THREE-DIMENSIONAL CHARACTERISTICS OF SUPERSONIC JETS

KOJI TESHIMA (Kyoto University of Education, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 1042-1048. Research supported by MOESC and Institute of Space and Astronautical Science. refs
Copyright

Supersonic free-jets issuing from circular, square, rectangular with different aspect ratios, and regular triangular orifices are visualized by means of a laser-induced fluorescence method. It is shown that, for the circular orifice, the axisymmetry of the jet structure is collapsed by increasing the stagnation pressure and the gas expansion in the plane normal to the axis becomes strongly nonuniform in the polar direction. For the square orifice, the cross section of the jet becomes also square, but their sides incline 45 degrees to those of the orifice. For the rectangular orifices, the shape of the cross section becomes rhomb with the direction of the longer diagonal consistent with the width direction of the orifice. The longer diagonal becomes longer than the other as the aspect ratio increases. For the regular triangular orifice, the cross section of the jet becomes reverse to the orifice shape. The jet structures for the orifices with sharp corners are well defined, and the direction of expansion in the plane normal to the axis can be well predicted. Author

A92-52810

KINETIC ANALYSIS OF FILM CONDENSATION AT THE ENDWALL OF A SHOCK TUBE

TAKEO SOGA (Nagoya University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 1258-1265. refs
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A linearized kinetic model equation with Oseen-like approximation was applied to study unsteady film condensation of methanol vapor behind a reflected shock wave at the endwall of shock tube. With disregard of a negligible temperature drop through a thin film of (less than 200 nm in thickness) liquid growth rate of the liquid film was obtained. Effects of accommodation coefficients on the growth rate were studied, introducing a Maxwell's model of differential reflection probability. The obtained growth rate with mass accommodation coefficient (i.e., condensation coefficient) $\alpha_p(c) = 0.25$ showed an excellent agreement with experimental results. The condensation coefficient thus obtained agreed well with theoretical prediction based on the transition state theory. Author

A92-52813

KINETIC ANALYSIS OF CONDENSATION ACCOMPANIED WITH TRANSONIC FLOW

TAKEO SOGA (Nagoya University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium,

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Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 1293-1300. refs
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A linearized kinetic model equation with Oseen-like approximation was applied to study the condensation accompanied with transonic flows. An analogy of (normal) slip flow to the inviscid subsonic and supersonic flow was examined. A boundary layer solution was derived from the model equation for the slightly supersonic condensation flow. Using this solution, p-M diagram (i.e., pressure vs Mach number) for the transonic region as well as subsonic region was obtained. Present results showed a good agreement with the results of nonlinear analyses. It was also found that for high-subsonic evaporation flow boundary layer emerged adjacent to the Knudsen layer. Thickness of the boundary layer diverges as the flow Mach number approached unity, while the thickness of the Knudsen layer remained finite. As a consequence, applicability of the linearized theory to the normal slip flow was justified. Author

A92-53028

DIRECT NUMERICAL SIMULATION OF PASSIVE SCALAR FIELD IN A TURBULENT CHANNEL FLOW

N. KASAGI, Y. TOMITA, and A. KURODA (Tokyo, University, Japan) ASME, Transactions, Journal of Heat Transfer (ISSN 0022-1481), vol. 114, no. 3, Aug. 1992, p. 598-606. refs
(Contract MOESC-02302043)
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A direct simulation was of the fully developed turbulent thermal field in a two-dimensional channel between two isoflux walls was carried out at a low Reynolds number and $Pr = 0.71$. Some of the thermal turbulence statistics are presented and compared with previous experimental and numerical results. The detailed budgets for the temperature variance, its dissipation rate, and the turbulent heat fluxes are calculated and discussed. V.L.

A92-53053

NUMERICAL SIMULATION AND FLOW-VISUALIZATION EXPERIMENT ON DEFORMATION OF PSEUDO-ELLIPTIC VORTEX RINGS

M. KIYA (Hokkaido University, Sapporo, Japan), K. TOYODA (Hokkaido Institute of Technology, Sapporo, Japan), H. ISHII, M. KITAMURA (Hokkaido University, Sapporo, Japan), and T. OHE (Hokkaido Institute of Technology, Sapporo, Japan) Fluid Dynamics Research (ISSN 0169-5983), vol. 10, no. 2, Aug. 1992, p. 117-131. refs
(Contract MOESC-03452120)
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The deformation of a pseudoelliptic vortex ring with circulation Γ was studied by a three-dimensional vortex blob method which included the viscous diffusion of vorticity. The circumference of this vortex ring consisted of two parallel line segments of the same length connected by two semicircles of the same radius R , the length of the major axis being denoted by L . The cross section of the vortex ring was represented by multiple vortex blobs with overlapping cores, while the circumference of the vortex ring was divided into a number of such sections. Numerical calculations were performed for the aspect ratios $L/2R = 2.0-12.0$, the initial core radius equal to $0.20 R$, and Reynolds number $\Gamma/\nu = 1500$, ν being the kinematic viscosity. The vortex rings yielded four fundamental patterns of deformation which included the axis switching and the split, depending on the aspect ratio. A flow-visualization experiment confirmed three of the four fundamental patterns, and was in sufficient agreement with the computation for the period of the axis switching and the time of the split. Author

A92-53550

DETAILED NUMERICAL ANALYSIS OF STANDING OBLIQUE DETONATION

AKIKO MATSUO (Recruit Co., Ltd., Institute for Supercomputing Research, Tokyo, Japan) and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990,

Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 735-740. refs

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In an attempt to understand the characteristics of supersonic combustion for the development of supersonic combustor ramjet engines, a detailed analysis is presented of the 3D standing oblique detonation (SOD) in a realistic oxyhydrogen mixture in front of a blunt obstacle. It is found that the SODs are decoupled for any incoming Mach number and that the diameter of the flying object is an important factor in establishing a perfectly coupled SOD. No large-amplitude periodic instability is found. C.D.

A92-53551

RADIATION HEAT TRANSFER FROM A SHOCK LAYER TO A BLUNT BODY IN AN EQUILIBRIUM HYPERSONIC FLOW

AKIHIRO SASOH, XIN-YU CHANG, and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 741-746. refs

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This paper describes the method and results of calculation of radiation heat transfer to a blunt body from a thermofluid-dynamically equilibrium shock layer. The band method employed here saves the computer memory size necessary for spectral radiative transfer calculation. The dominant species for the radiative heat transfer are found to be atomic species and $N_2(+)$ (first negative band system). The emission power is sensitive to the density and temperature of electrons. As a result, the wall temperature condition considerably affects the radiative heat flux since the densities of radiative species and electrons near the wall depends strongly on the boundary condition. The highest radiative heat flux to the wall calculated here has amounted to $7.5 \times 10^5 \text{ W/sq m}$, which is higher than the convective one and certainly is not negligible in designing a reentry vehicle. Author

A92-53554

BLAST WAVE SIMULATION WITH GROUND SURFACE EFFECT

KOZO FUJII (Institute of Space and Astronautical Science, Sagami-hara, Japan), FUMIO SHIMIZU (Tokyo University of Agriculture and Technology, Koganei, Japan), YOSHIKI TAMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan), FUMIO HIGASHINO (Tokyo University of Agriculture and Technology, Koganei, Japan), MOTOKI HINADA, and RYOJIRO AKIBA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 759-764. refs
Copyright

Unsteady flowfield generated by the finite strength of a shock wave is computationally simulated with the discretization method. The results indicate that the overpressure depends on the ground surface geometry as well as the distance from the point of explosion. The present approach using the new computational-fluid-dynamic technology may improve the existing theory for estimating the unsteady motion and decay of blast waves and eventually lead to better estimation of the safety distance for rocket launching. Author

A92-53570

DEVELOPMENT OF DROPLET GENERATOR FOR LIQUID DROPLET RADIATOR

SHUNSUKE HOSOKAWA, MASAKUNI KAWADA, AKIRA IWASAKI, and ISAO KUDO (Electrotechnical Laboratory, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 863-870. refs
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A single-nozzle liquid droplet generator was fabricated and tested as part of a program aimed at the development of a liquid droplet generator for the liquid droplet radiator (LDR). The droplet

generator uses diffusion pump oil as the working fluid. The pressurized oil is squirted from an orifice in the form of a liquid jet which is perturbed by an electrically driven oscillating piezoceramic disk. The growing oscillations eventually break up the liquid jet, and the droplets are formed with the same frequency as the oscillation. Results of vacuum chamber tests of the droplet generator indicate that the droplet velocity, droplet diameter, and the spacing between adjacent droplets satisfy the LDR design requirements. V.L.

A92-53574

A STUDY ON THE THERMAL DESIGN OF COMMUNICATIONS SATELLITE MISSION PANELS WITH HEAT PIPES

HIROSHI FUJINO (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 891-896.

Copyright

An algorithm is proposed that rapidly develops practical heat pipe networks for radiator panels. The algorithm uses one thermal math model for the whole panel. The heat flows from electronic components are reassigned to heat pipes and facesheet nodes to minimize the number of nodes. The algorithm iteratively examines the effect of concentrating heat pipes above 'hot' components and dispersing heat pipes to 'cold' facesheet regions. The effectiveness of the algorithm is confirmed through the optimization of a radiator panel. Author

A92-53575

A HEAT TRANSPORT CAPABILITY ESTIMATION OF HEAT PIPES EMBEDDED IN HONEYCOMB SANDWICH PANEL

AKIHIRO MIYAZAKA and KATSUHIKO NAKAJIMA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 897-902. refs

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The maximum heat load for heat pipes that are embedded in honeycomb sandwich panels with multi-point heating is evaluated by using a heat flow rate. The accuracy of the proposed method for determining the maximum heat load is certified by experiment for dry out of heat pipes. In addition, an estimation of the maximum heat transport capability of heat pipes for several heat source arrangements and heat loads are also clarified. The experimental results showed that this method was extremely useful and accurate for calculating the maximum heat load to heat pipes. Author

A92-53628

THERMAL CHARACTERISTICS OF SODIUM HEAT PIPE IN A VACUUM ENVIRONMENT

TSUTOMU FUJIWARA, SACHIO OGIWARA, YOSHIHIRO NAKAMURA, and KUNJIHISA EGUCHI (National Aerospace Laboratory, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1269-1274. refs

Copyright

As a first step to develop an efficient heat transfer device for space use, the evaluation tests of a single straight heat pipe with a screen mesh wick have been run in a sodium vapor temperature range of 500 to 800 C to determine the heat transfer rates in vacuum while the transported heat is dissipated only by radiative cooling. A heat shield consisting of multi-layers of highly reflective foil was used to minimize the radiation loss. From a series of electrically-heating tests, the thermal radiation rates and the emissivities of shield and condenser surfaces were determined from temperature measurements. In a horizontal heat pipe operation, axial temperature distributions and heat transfer rates for two different condenser lengths were compared. The results indicate that the temperature is almost uniform in the condenser for all other cases than the maximum cooling capability case, and

that the heat transfer capability can be almost achieved as usually expected from the radiation cooling. Author

A92-53754

GAS EVAPORATION IN LOW GRAVITY WITH AN AIRPLANE. II

NOBUHIKO WADA (Nagoya University, Japan), MANABU KATO, MINORU DOI, SHINYA SAWAI, MASAKI TANI, and TOSHIAKI GOTOH IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2143-2145. refs

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An airborne investigation was conducted of the pressure dependence of gas-evaporation modes in microgravity conditions. Explosive evaporations are observed to occur in Ag at the higher pressures, and dendritic patterns are noted in large particles. The emission of evaporant molecules from their sources exceeds their rate of diffusion in an inert gas atmosphere; the emitted molecule would therefore have to accumulate around the source of the evaporation. Explosions result when the accumulated vapor pressure exceeds atmospheric pressure. O.C.

A92-53755

EXPERIMENTAL STUDY OF CONVECTION EFFECTS AROUND THE PHASE CHARGE INTERFACE

AKIRA IWASAKI (Electrotechnical Laboratory, Tsukuba, Japan), SHUNSUKE HOSOKAWA, MITSUMORI TANIMOTO, and ISAO KUDO IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2153-2158. Research supported by Space Technology Research and Development Group of Japan. refs

Copyright

An experimental apparatus was developed for observation of the transport phenomena in liquid together with the interface phenomena during unidirectional solidification processes of transparent material. An incoherent moire interferometric technique, which eliminated wavefront deformation by the interference of two interferograms at different times, made it possible to visualize the temperature profile in liquid. A time-dependent temperature profile in liquid was taken, and the growth rate of the solid-liquid interface was measured. It was found that when supercooled liquid was solidified quickly, the temperature reversed layer appeared due to the released latent heat, which was conducted not only to the solid but also to the liquid. The effect of thermal convection in an unstable system was also observed. Author

A92-53757

EFFECTS OF NATURAL CONVECTION ON MOVING BOUNDARY PROBLEM

YOSHINORI FUJIMORI, HIDEO KIMURA, TOMOHIRO KUSUNOSE (NASDA, Tokyo, Japan), HIROHIKO NAKAMURA, SHIN-ICHI KAMEI, and MASAMICHI ISHIKAWA (Mitsubishi Research Institute, Inc., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2165-2169. refs

Copyright

To evaluate coupled solidification-convection phenomena, the numerical solution of moving boundary problems (Stefan problems) were solved using the Boundary Fixing Method. The results were compared with the melt growth of succinonitrile under careful adjustment of thermal boundary conditions. The method is valid except for the initial stage of solidification, where supercooling dominates growth rate. Natural convection caused the significant lowering of growth rate, relative to the case of diffusion transport. The solidified interfaces were curved, corresponding to the convective patterns in the melt. Flight experiments are suggested to evaluate the contribution of gravity on moving boundary problems. Author

A92-53758

FUNDAMENTAL STUDIES ON MARANGONI CONVECTION RELATED TO BRIDGMAN CRYSTAL GROWTH

KEIICHI KUWAHARA, SHINTARO ENYA, RYO AKIYOSHI, JUN-ICHI OCHIAI, and HIROYUKI UCHIDA (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2171-2178. Research supported by Science and Technology Agency of Japan. refs

Copyright

Transient flow in liquid column during Bridgman crystal growth was visualized in a simulation on aircraft in parabolic flight. The observed flow field revealed the free liquid surface to be subjected to strong Marangoni effect. The value obtained in the present experiment under low gravity on thermal Peclet number and on Marangoni number proved to agree quite well with the relation between these numbers determined from ground experiment and from approximate numerical solution. And the effect of Prandtl number on the flow field in the melting liquid under microgravity was investigated with visualization experiments and with numerical analysis. Application of these results to semiconductor melt suggested the possibility that the flow velocity exceeds the diffusion velocity.

Author

A92-53759

ANALYSIS OF MARANGONI FLOW

YASUNORI MIYATA (Nagaoka University of Technology, Japan), HIROSHI SAKUTA, and TOSHIO SUZUKI IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2179-2184. refs

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The aim of this study is to fabricate a compact observing system for 2D Marangoni flow which is applicable in a falling experiment, and then to construct an analyzing computer-simulation code for the flow. The equipment is composed of an experimental cell filled by silicone-oil, a lighting laser, the observing CCD camera, and a system controller. At a given condition on the earth, the pattern and velocity of the flow are observed by the trace of the aluminium powder which is suspended in the silicone oil in the experimental cell. The variation of the temperature of the oil with time is also measured. The simulation code has predicted the pattern, the velocity of the flow and development of the temperature of the oil with time. These predictions are compared with values measured by the experiments. The results of the simulation analysis and of the experiments corresponded well.

Author

A92-53760

COMPUTER SIMULATION OF FLUID FLOW WITH THERMOCAPILLARY MOTION AND SURFACE DEFORMATION

MITSURU OHNISHI, SHOICHI YOSHIHARA, and HISAO AZUMA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2185-2190. refs

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A new computer program is presented for problems of 2D and time-dependent fluid flow with thermocapillary motion and surface deformation. To demonstrate the capability of the program, transient and thermocapillary motion of a drop having a hot and spherical region under zero gravity is computed. The simulation result shows that high Marangoni number collaborates with high capillary number and high Prandtl number in causing a large surface deformation to the drop.

Author

A92-53783

CHARACTERISTIC-EDDY DECOMPOSITION OF TURBULENT MIXING LAYER

TOMOKI KAWAKUBO (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing,

Inc., 1990, p. 2337-2342. refs

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The Karhunen-Loeve expansion, which is presently shown to extract organized structures from turbulent mixing layers by decomposing the velocity field into characteristic flow patterns and corresponding random coefficients, indicates that the first and second characteristic structures, respectively, carry over 50 and nearly 18 percent of the total turbulent kinetic energy. These modes are noted to represent the vortex-coalescence processes occurring at various regions in the flow field.

O.C.

A92-53786

EFFECT OF POROSITY IN TRANSPIRATION COOLING SYSTEM

SHIRO YAMAMOTO (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2355-2360. refs

Copyright

Transpiration cooling is a candidate thermal protection system against aerodynamic heating. Porous matrices may have many characteristics which affect the efficiency of this system. In the present experiment, porosity effects were evaluated in a relatively low radiative heating environment. CO₂ and helium were used as cooling gas. The evaluation was performed by measuring the surface and the inner temperature. In the range of porosity, flow rate and cooling gas type, in this experiment, the surface temperature is scarcely affected by porosity. This is temperature difference between fluid flow and no fluid flow cases. CO₂ is more effective. The inner temperature, is affected by porosity, flow rate and cooling gas type.

Author

A92-53787

A NUMERICAL SIMULATION OF SINGLE-PHASE AND GAS-SOLID TWO-PHASE OPPOSED JETS WITH NAVIER-STOKES EQUATION

NOBUYUKI TSUBOI (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2361-2366. refs

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An opposed jet is useful for the attitude control of a spaceplane, a satellite, and other spaceships. Its fluid mechanical structure is quite complicated, with a detached shock wave (a bow shock wave), a contact surface, a Mach disk, and turbulent structure. Analysis is focused on the structure of the single-phase and the gas-solid two-phase opposed jet flows as an application for the attitude control jets. The purpose of study is to explain numerically the details of the physical phenomena in the single-phase and gas-solid two-phase opposed jets, using the Navier-Stokes equations.

Author

A92-54499

NUMERICAL SIMULATION OF REACTIVE FLOWS BY A TIME-SPLIT ALGORITHM

S. G. R. KUMAUER and TOSHI FUJIWARA (Nagoya University, Japan) Nagoya University, Faculty of Engineering, Memoirs (ISSN 0027-7657), vol. 43, no. 2, 1991, p. 258-274. refs

The propagation of shock-initiated reaction in a 2D channel is studied by a time-split algorithm. The convection and reaction processes are solved in a decoupled manner. The Euler equation describing the 2D inviscid flow is solved by an explicit TVD scheme, while the equations describing the reaction kinetics are solved implicitly at each nodal point. The initiation of combustion by a shock wave and its development into a detonation in a 2H₂ + O₂ + 7 Ar system are studied using the present algorithm. The time history of the process is presented.

Author

A92-54958

STATISTICAL ANALYSIS OF COMPRESSIBLE TURBULENT SHEAR FLOWS WITH SPECIAL EMPHASIS ON TURBULENCE MODELING

AKIRA YOSHIKAWA (Tokyo, University, Japan) Physical Review

A (ISSN 1050-2947), vol. 46, no. 6, Sept. 15, 1992, p. 3292-3306. refs

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Compressible turbulent shear flows are analyzed using a two-scale direct-interaction (propagator-renormalization) approximation with the density, velocity, and internal energy as the primitive variables. This method elucidates the effects of fluid compressibility on various important correlation functions that appear in the equations for the mean field. Specifically, density fluctuations are confirmed to be closely linked with compressibility effects. These results show that the current one-point turbulence model based on mass-weighted averaging, which is widely used in aeronautical studies, obscures many important features of fluid compressibility. On this basis, modeling based on the combined use of ensemble averaging and primitive variables is recommended as the one-point turbulence modeling applicable to the study of aerospace and astrophysical phenomena. Author

A92-54962

PARAMETRIC EXCITATION OF BUOYANCY OSCILLATION AND FORMATION OF INTERNAL BOUNDARY LAYERS IN A STABLY STRATIFIED FLUID

TAKESHI MIYAZAKI (University of Electro-Communications, Chofu, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 10, Oct. 1992, p. 2145-2150. refs

Copyright

Resonant excitation of buoyancy oscillation by strained vertical vortices in a stably stratified fluid, which leads to formation of new internal boundary layers, is investigated theoretically. Any two-dimensional steady vorticity distributions, uniform in the vertical direction, are allowable under the Boussinesq approximation (i.e., at the zeroth order of Froude number (Fr) expansions). But such an inviscid solution shows algebraic divergence at the first order. This anomaly is attributable to the resonance between the vertical oscillation due to a gravitational restoring force and the rotational motion of a fluid particle along a closed streamline. Weak viscous and diffusive effects are incorporated in order to remove the singularity and to obtain stationary solutions. Author

A92-54968

A NUMERICAL STUDY OF NONLINEAR WAVES IN A TRANSCRITICAL FLOW OF STRATIFIED FLUID PAST AN OBSTACLE

HIDESHI HANAZAKI (National Institute for Environmental Studies, Tsukuba, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 10, Oct. 1992, p. 2230-2243. refs

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A numerical study of the flow of stratified fluid past an obstacle in a horizontal channel is described. Upstream advancing of waves near critically (resonance) appears in the case of ordinary two-layer flow, in which case the flow is described well by the solution of the forced extended Korteweg-de Vries (KdV) equation which has a cubic nonlinear term. It is shown theoretically that the upstream waves in the general two-layer flow cannot be well described by the forced KdV equation except when the wave amplitude is very small. The critical-level flow is also governed by the forced extended KdV equation. However, because of the smallness of the coefficient of the quadratic nonlinear term, the bore cannot propagate upstream at exact resonance. The results for the linearly stratified Boussinesq flow show good agreement with the solution of the Grimshaw and Yi (1991) equation, at least for exact resonance. Author

A92-54972

BEHAVIOR OF TURBULENCE IN THE NEAR WAKE OF A THIN FLAT PLATE AT LOW REYNOLDS NUMBERS

MICHIO HAYAKAWA and SEI-ICHI IIDA (Hokkaido University, Sapporo, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 10, Oct. 1992, p. 2282-2291. Research supported by MOESC. refs

Copyright

Conventional hot-wire measurements have been made in the turbulent developing wake of a thin flat plate. The data obtained

are primarily concerned with turbulence characteristics in the near-wake region. Turbulence properties in the inner wake first increase up to a streamwise distance of 200-300 times the initial wall-layer length scale, followed by a gradual decay farther downstream. The mechanism of this overshoot phenomenon is inferred from space-time correlation data. Quasi-periodic motion similar to that in the far wake is observed as early as near the end of the near wake. Author

A92-55427

EXPERIMENTAL AND NUMERICAL STUDIES OF FOCUSING PROCESS OF WEAK SHOCK WAVES

KOJI IZUMI, TERUYUKI NAKAJIMA, SHIGERU ASO, and MICHIO NISHIDA (Kyushu University, Fukuoka, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 52, no. 2, June 1992, p. 233-242. refs

This paper describes numerical and experimental studies of a weak shock wave reflected from various shapes of the parabolic reflector. Experiments have been carried out using a conventional shock tube with air as test gas at an incident shock Mach number of 1.1. In the experiments, the process of the shock focusing have been visualized by a Schlieren technique. Numerical studies have been conducted using a two-dimensional inviscid flow model. Thus obtained numerical results have been compared with the experimental ones for various reflector shapes and satisfactory agreement have been obtained. Author

A92-55452

INVESTIGATION OF THE PROPAGATION OF THE HEAVY MONOATOM BEAM

KAZUNORI SHIODA, YOSHIO HASHIDATE, and SHIGEO NONAKA (Toshiba Corp., Heavy Apparatus Engineering Laboratory, Yokohama, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 3, Aug. 1992, p. 361-369. refs

In this paper, the numerical analyses on the behavior of a heavy monoatom beam are presented. Some numerical methods for the analysis of rarefied gas flow have been proposed thus far, which have been successfully applied to the flow of Kn less than 1, such as in the semiconductor manufacturing processes and other vacuum technologies. However, since the atomic number density of the beam is extremely low, the flow here is categorized as molecular (Kn greater than 1), in which the atomic free path is rather large compared with the representative scale of the beam. Hence, the probability density function of the atomic free path in the nonequilibrium field was taken into account in the numerical simulation of the beam propagation. Consequently, the calculated results of the beam diffusion due to mutual atomic scattering agreed well with the measured data obtained using gadolinium vapor. Author

A92-56039

A POTENTIAL FLOW THEORY OF TWO-DIMENSIONAL BIFURCATED CURTAIN JETS. II

SYUNRO NAKAMURA IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 162-165. In Japanese. refs

A calculation method for the potential theory of bifurcated curtain jets is presented. The velocity and pressure distribution of nozzle outlet flow are analyzed, and ground pressure distribution is examined. Y.P.Q.

A92-56869

NUMERICAL CALCULATION OF PERIODIC VISCOUS FLOW THROUGH A CIRCULAR HOLE

T. NOTOMI and M. NAMBA (Kyushu University, Fukuoka, Japan) Journal of Sound and Vibration (ISSN 0022-460X), vol. 157, no. 1, Aug. 22, 1992, p. 41-65. refs

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Periodic viscous flows through a circular hole driven by fluctuating far field pressure are studied numerically. The time dependent incompressible Navier-Stokes equations formulated with orthogonal curvilinear co-ordinates are solved by using a finite

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difference method. The flow patterns and acoustic impedance of the circular hole are investigated for various combinations of the pressure/viscous force ratio, frequency and hole edge thickness. Numerical calculations revealed some interesting facts, as follows. First, the flow patterns are classified into three regimes by fluctuating pressure amplitude and frequency: flows with no laminar separation (high-frequency-low-pressure range), flows with attached separation bubble (intermediate frequency and pressure range) and flows with detached vortex rings (low-frequency-high-pressure range). Second, the flow resistance of the circular hole is proportional to the acoustic particle velocity but independent of the viscosity of the fluid, and almost invariant with the frequency for the low-frequency-high-pressure range. On the other hand, for the high-frequency-low-pressure range, the flow resistance is independent of the periodic pressure amplitude and varies directly with the $2/3$ power of the frequency. Finally, the predicted circular hole impedance is in good agreement with the experimental data for the orifice impedance of Ingard and Ising. Author

A92-57284

LIQUID COLUMN AND MARANGONI FLOW EXPERIMENTS USING TR-IA SOUNDING ROCKET

H. AZUMA, M. OHNISHI, S. YOSHIHARA (National Aerospace Laboratory, Tokyo, Japan), S. YODA (NASDA, Tokyo, Japan), and K. KAWASAKI (Nissan Motor Co., Ltd., Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 7 p. refs (IAF PAPER 92-0903) Copyright

Experiments on Marangoni convection, thermally driven waves and the breaking of a liquid column were performed under microgravity in a liquid column of silicone oil using the TR-IA sounding rocket. Observed results are described and compared with computer simulations. Author

N92-10166# National Aerospace Lab., Tokyo (Japan).

NUMERICAL ANALYSIS OF FULLY DEVELOPED LAMINAR FLOW IN CURVED RECTANGULAR CHANNELS

HITOSHI YAMADA, HIROSHI ISHIGAKI, and MUNEKAZU MOCHIZUKI (National Aerospace Lab., Kakuda, Japan) May 1991 10 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1111) Avail: CASI HC A02/MF A01

The Navier-Stokes equations were numerically solved using a finite volume method to simulate steady, fully developed, incompressible, and laminar flow in curved rectangular channels. Accurate solutions were obtained for a Dean number up to 550 by using the power-law scheme, whereas up to 900 using the up-wind scheme. Numerical results were compared with available experimental and theoretical results, and it was subsequently determined that the friction factor is approximately 6 percent larger when the secondary flow changes from a two vortex to a four vortex pattern (Dean number = 116). In addition, the friction factor's slope was found to be different in the two and four vortex region. The calculated friction factor showed better agreement with the experimental results than did the other investigated theoretical results. Author

N92-11298# National Aerospace Lab., Tokyo (Japan).

THEORETICAL ESTIMATION OF THE VISCOUS DAMPING FROM LIQUID TRANSIENT MOTION IN TANKS

KEIJI KOMATSU and JYUN-ICHIROU SHIMIZU (Tsukuba Univ., Japan) Feb. 1991 12 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1095) Avail: CASI HC A03/MF A01

The dynamic behavior of liquid propellants in launch vehicles and spacecraft has been of great importance in generating vehicle designs. Presented here is a method to estimate the viscous dissipative force for the transient motion of liquid propellants in tanks. The estimation algorithm is combined into the Large Amplitude Sloshing (LAMPS) algorithm, where the dissipative values have been approximated from test data. Analytical predictions show excellent agreement with existing test results. Author

N92-12197# Central Research Inst. of Electric Power Industry, Tokyo (Japan).

DEVELOPMENT OF ADVANCED FLOW SIMULATION SYSTEM BY WATER FLOW MODEL

JUN INUMARU, SABURO HARA, TERUhide HAMAMATSU, and TOSHIO ABE May 1989 28 p In JAPANESE; ENGLISH summary (DE90-503438; CRIE-W-88041) Avail: CASI (US Sales Only) HC A03/MF A01

The automatic velocity vectors measurement system used a high speed VTR in flow analyzing system by water flow model which was developed to find the properties of mixed flow in combustion equipment, was newly developed. In this system, the ray through slit was irradiated to the water flow with the tracer of hollow glass particulates and the visualized flow was realized. The density fluctuation of the two points on picture image which is continuously taken at 10 msec space, and flow velocity was measured by the correlation with the both stated above. The direction of the flow was determined by the angle in which coefficient of correlation is maximum when one of these points was turned. It was found that the spaces of data sampling was shortened from 33 to 19 msec, and they were capable to be measured up to 3 m/s of comparatively high speed, and application to usual flow experiment became to be possible. It was found that the speed vector obtained by the application to axial symmetric impact jet, coincides with the result of the existing experiment or calculation, and the vector became quantitatively proper to actual turbulent flow. DOE

N92-12209# Oak Ridge Y-12 Plant, TN.

EXTRACTION APPARATUS WITH PULSED COLUMNS FOR MONITORING DISPERSED PHASE

KOJI AIBA, KATSUNORI OUCHI, and TAKAHIRO OKUMA (Sumitomo Metal Mining Co. Ltd., Tokyo, Japan) 1991 9 p Transl. into ENGLISH of Japanese Patent No. 1-148304, (9 Jun. 1989)

(Contract DE-AC05-84OS-21400)

(DE91-017680; Y/TR-91/35) Avail: CASI HC A02/MF A01

The invention pertains to a method and extraction apparatus with pulsed columns for monitoring the dispersed phase that calculates by means of using ultrasonic waves the dispersion that forms on the boundary between the light liquid phase and the heavy liquid phase in the pulsed columns. With the invention, the outer wall of the pulsed column of an extraction tower is irradiated with ultrasonic waves, the radioactive waves or the transmitted waves are received, and the dispersion of the dispersed phase in the pulsed columns is calculated on the basis of the level of radioactive or transmitted waves. DOE

N92-12221# Oak Ridge National Lab., TN.

HEAT-TRANSFER MATERIAL

MASAHIITO KATAYAMA (Oak Ridge National Lab., TN.), HIROSHI SATO (Oak Ridge National Lab., TN.), YOSHIHISA TAKIZAWA (Oak Ridge National Lab., TN.), MASANOBU ASAOKA (Oak Ridge National Lab., TN.), and TSUGIHIRO FUKUDA (Canon, Inc., Tokyo, Japan) 1991 28 p Transl. into ENGLISH of Japanese Patent No. SHO 63(1988)-309493, (16 Dec. 1988)

(Contract DE-AC05-84OR-21400)

(DE91-017723; ORNL/TR-91-13) Avail: CASI HC A03/MF A01

The present invention concerns heat transfer material used for heat transfer recording, especially heat transfer material providing good recorded images on a substrate of poor surface smoothness, and the images can be corrected by a liftoff correction tape that produces adhesive properties when heated. DOE

N92-13394# Central Research Inst. of Electric Power Industry, Tokyo (Japan).

DEVELOPMENT OF ADVANCED HEAT PUMPS, PART 4

MICHIYUKI SAKAWA, TETSUSHIRO IWATSUBO, and TERUhide HAMAMATSU Feb. 1989 28 p In JAPANESE; ENGLISH summary

(DE90-503046; CRIE-W-88021) Avail: CASI (US Sales Only) HC A03/MF A01

34 FLUID MECHANICS AND HEAT TRANSFER

As part of the development of advanced heat pump systems for air-conditioning and hot water supply, the performance of a prototype system was evaluated. Technologies associated with the systems practical use were investigated, and topics of future interest were examined. The results from the investigation are presented. DOE

N92-15333# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

HOT WIRE MEASUREMENT OF CROSS-LINKING AND UNLINKING IN UNITING TWO CIRCULAR VORTEX RINGS

NAOKI IZUTSU and YUKO OSHIMA (Ochanomizu Women's Univ., Tokyo, Japan) Mar. 1991 54 p (ISSN 0285-6808)

(ISAS-638) Avail: CASI HC A04/MF A01

A laminar circular vortex ring with excellent reproducibility can be generated by pushing a mass of air through a circular orifice drilled on a buffer plate placed in front of a loudspeaker, which is driven by a stepwise voltage signal. In order to obtain complete information concerning the velocity fields during the 'uniting' of two circular vortex rings, phase-locked velocity measurement was carried out by using a single inclined hot wire point by point all over the flow field, and the vorticity fields were computed from the measured velocity fields. The vortex tubes representing the vortex rings were computed as well as the behavior of the fluid material initially held within the vortex ring, and the important differences among the vorticity, vortex tubes, and fluid materials being transported by following the velocity field were explained so as not to misread the real phenomenon and the substance of the physical mechanism. The through process can be divided into the terms of formation and approaching, first cross-linking and unlinking, second cross-linking and unlinking and decay. The first cross-linking and unlinking is 'positive' and finishes successfully by the continuous and increasing driving force on the adjoined original 'near' segments being pressed against each other, while the second cross-linking and unlinking is 'negative' and depends on the initial condition due to the monotonously decreasing driving force on the adjoined original 'far' segments in the united vortex ring. As the continuous induced velocities on the approaching and adjoining segments force the segments harder against each other, the flow region in their gap is narrowed, and immediately after, the gap cannot hold the whole flux; the flow overflows outward to create another velocity gradient that is observed as the sudden appearance of two new concentrated vorticity regions between the adjacent vortex tubes. Therefore, the vorticity in the adjoined original vortex tubes is transported, although no vorticity cancellation is recognized in the present measurement because the time scale of cancellation is much longer than that of the cross-linking and unlinking. Author

N92-16245# Japan Atomic Energy Research Inst., Tokyo. ESTIMATION OF SHEAR STRESS IN COUNTER-CURRENT GAS-LIQUID ANNULAR TWO-PHASE FLOW

YUTAKA ABE, HAJIME AKIMOTO, and YOSHIO MURAO Jan. 1991 89 p In JAPANESE; ENGLISH summary Prepared in cooperation with Japan Atomic Energy Research Inst., Ibaraki (DE91-780243; JAERI-M-90-215) Avail: CASI HC A05/MF A01

The accuracy of the correlations of the friction factor is important for the counter-current flow (CCF) analysis with two-fluid model. However, existing two fluid model codes use the correlations of friction factors for co-current flow or correlation developed based on the assumption of no wall shear stress. The assessment calculation for two fluid model code with those existing correlations of friction factors shows the falling water flow rate is overestimated. Analytical model is developed to calculate the shear stress distribution in water film at CCF in order to get the information on the shear stress at the interface and the wall. The analytical results with the analysis model and Bharathan's CCF data shows that the wall shear stress acting on the falling water film is almost the same order as the interfacial shear stress and the correlations for co-current flow cannot be applied to the counter-current flow. Tentative correlations of the interfacial and the wall friction factors are developed based on the results of the present study. DOE

N92-18483# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

PROCEEDINGS OF THE SEMINAR ON INVESTIGATION AND CONTROL OF BOUNDARY-LAYER TRANSITION (KYOKAISO SENI NO KAIMEI TO SEIGYO KENKYUKAI KOENSHU)

NOBUTAKE ITO (National Aerospace Lab., Tokyo (Japan).), MICHIO NISHIOKA (National Aerospace Lab., Tokyo (Japan).), KIYOSHI YAMAMOTO (National Aerospace Lab., Tokyo (Japan).), YASUAKI KOHAMA (National Aerospace Lab., Tokyo (Japan).), NAOKI HIROSE (National Aerospace Lab., Tokyo (Japan).), YOJI ISHIDA (National Aerospace Lab., Tokyo (Japan).), MICHIO OJI (National Aerospace Lab., Tokyo (Japan).), SHOHEI TAKAGI (National Aerospace Lab., Tokyo (Japan).), AKIRA ITO (Meiji Univ., Kawasaki, Japan), ICHIRO TANI et al. Jan. 1990 68 p In JAPANESE Seminars held from Sep. 1987 - Feb. 1989 (ISSN 0289-260X)

(NAL-SP-11; JTN-92-80287) Avail: CASI HC A04/MF A01

This report is a proceeding of 22 lectures presented at the study meeting on the Investigation and Control of Boundary-Layer Transition held four times from September 1987 to February 1989. It contains reports on the analysis of transition mechanism, three-dimensional boundary-layer transition, transition control, and other topics. This group consists of researchers participating in applications research for fundamental studies on boundary layer transition, with the aim of exchanging their opinions and discussing them thoroughly. Recently, lectures and discussions have been ranging over more subjects including not only transition problems but also analysis of turbulence flows and control methods to reduce viscous resistance. Author (NASDA)

N92-20918# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

PROCEEDINGS OF THE SYMPOSIUM ON MECHANICS FOR SPACE FLIGHT 1990

KOICHI OSHIMA, ed. Mar. 1991 97 p Symposium held in Sagamihara, Japan, 29 Nov. - 1 Dec. 1990 (ISSN 0288-433X)

(ISAS-SP-13) Avail: CASI HC A05/MF A02

Papers from the symposium are presented, and their topics include: (1) normal wall effect and the minimum critical Reynolds number for flow in a circular pipe; (2) study of capillary driven flow in a tube; (3) minimax optimization in the time domain; (4) attitude control system of the S-520 recovery type rocket; (5) intensification of phase change heat transfer; and (6) Brayton-Rankin total energy space dynamic power system analysis.

N92-20919# Tokyo Univ., Sagamihara (Japan).

NORMAL WALL EFFECT AND THE MINIMUM CRITICAL REYNOLDS NUMBER FOR FLOW IN A CIRCULAR PIPE

HIDESADA KANDA In its Proceedings of the Symposium on Mechanics for Space Flight 1990 p 3-23 Mar. 1991

Avail: CASI HC A03/MF A02

The stability of Hagen-Poiseuille flow in the entrance region is studied with particular emphasis on the effect of a smooth wall. It is generally known from boundary-layer theory that the radial pressure distribution is almost constant, and from the Bernoulli equation that the pressure near the wall is higher than that in the central core. However, the results of calculation, computed by solving directly the stream-function vorticity formulation and the Poisson equation, conflict with these findings. We must therefore consider the existence of a normal force that balances the pressure drop. Numerical calculation reveals a paradox and two necessary parameters that determine the transition, and thus we can obtain the minimum critical Reynolds number of 2165 and can also estimate a critical Reynolds number that is consistent with experimental observation. Author

N92-20920# Tokyo Univ., Sagamihara (Japan). Dept. of Applied Physics and Information Science.

STUDY OF CAPILLARY DRIVEN FLOW IN A TUBE

NAOKI ICHIKAWA, TAKESHI NAKADA, YOKO SATODA, and

34 FLUID MECHANICS AND HEAT TRANSFER

MASAHIDE MURAKAMI *In its Proceedings of the Symposium on Mechanics for Space Flight 1990* p 25-36 Mar. 1991
Avail: CASI HC A03/MF A02

This paper describes the dynamics of liquid in a tube driven by capillary force. The movement of a gas-liquid interface in a horizontal tube as a result of capillary action is experimentally investigated in a microgravity environment onboard an airplane and on the ground. Theoretical analysis of interface dynamics is also presented. Dimensionless numbers representing time and distance scales are introduced to derive a unique functional relation. The experimental results are found to agree with the theoretical result. The dynamic contact angle and the dynamic surface tension are calculated from the small discrepancy between the theoretical and experimental values. The result is compared with the static values. Author

N92-20923# Tokyo Univ., Sagami-hara (Japan).

INTENSIFICATION OF PHASE CHANGE HEAT TRANSFER

S. V. KONEV *In its Proceedings of the Symposium on Mechanics for Space Flight 1990* p 53-67 Mar. 1991
Avail: CASI HC A03/MF A02

Heat and mass transfer phenomena by phase change under the action of capillary forces are examined. The obtained analytical and experimental results are applied to the basic development of unified heat pipes with capillary structures and extended heat transfer systems. Author

N92-23120# Oak Ridge National Lab., TN.

HEAT PUMP SYSTEMS WITH DIRECT EXPANSION GROUND COILS

O. J. SVEC and V. D. BAXTER 1991 22 p Presented at the 4th Conference and Equipment Show: Meeting Customers Needs With Heat Pumps, Dallas, TX, 15-18 Oct. 1991 (Contract DE-AC05-84OR-21400) (DE92-007831; CONF-911080-1) Avail: CASI HC A03/MF A01

This paper is a summary of an international research project organized within the framework of the International Energy Agency (IEA), Implementing Agreement on Heat Pumps. This cooperative project, based on a task sharing principle, was proposed by the Canadian team and joined by the national teams of the United States of America, Japan and Austria. The Institute for Research in Construction (IRC) of the National Research Council of Canada (NRCC), has been acting as the Operating Agent for this project, known as Annex XV. The need for this research work is based on the recognition of the state-of-the-art of Ground Source Heat Pump (GSHP) technology, which can simply be described by the following two statements: (1) GSHP technology is the most successful among all renewable technologies in North American and northern European countries; and (2) installation cost of GSHP systems is currently too high for a meaningful worldwide penetration into the heating/cooling market. DOE

N92-24532*# Tokyo Univ. (Japan). Inst. of Industrial Science.
THE PRESENT STATE OF DIA MODELS AND THEIR IMPACT ON ONE POINT CLOSURES

AKIRA YOSHIKAWA *In NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling* p 361-389 Mar. 1992
Avail: CASI HC A03/MF A04

An outline is presented of the DIA model. Another outline is presented of TSDIA (two scale DIA) and some suggestions for turbulence modeling. Two proposals are made: helicity for the study of the effects of swirling flow and cross flow; and density variance for the study of highly compressed flows. Author

N92-25874# Tsukuba Space Center, Ibaragi (Japan).

ANALYTICAL APPROACH TO MODULATION AND CONTROL OF PUMPED LIQUID LOOPS

MASAO FURUKAWA *In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1* p 381-389 Dec. 1991

Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

As a common basis for analyses and computations, practical

expressions on thermophysical properties of ten kinds of compressed liquids of concern are presented. All the analyses were made in dimensionless forms so as to offer more general expressions helpful in design practices of fluid loop controllers. Three kinds of control laws for a standard loop consisting of a cold plate, a space radiator, and a pump, are considered together with six kinds of control laws for two loops coupled with a heat exchanger of counterflow type. Their methods of control are either pump speed or bypass flow rate modulation. Off design operation problems of a pumped liquid system are solved to give modulation rates which permit maintaining the cold plate temperature at a specified value. Laplace images of transfer functions of a cold plate to step inlet temperature, step heat rate, and step flow rate and those of a space radiator to such step ones are also presented. They are expressed in rational functions with coefficients of which the reference values can theoretically be determined. Correction factors to them are listed as a result of numerical simulations. ESA

N92-26906# National Aerospace Lab., Tokyo (Japan).

PROCEEDINGS OF THE 5TH AND 6TH SEMINARS ON INVESTIGATION AND CONTROL OF BOUNDARY-LAYER TRANSITION [KYOKAISU SENI NO KAIMEI TO SEIGYO KENKYUKAI KOEN RONBUNSHU, DAI 5 KAI TO DAI 6 KAI]

Oct. 1990 55 p In JAPANESE Seminars held in Tokyo, Japan, 28-30 Jun. 1989 and 17-19 Jan. 1990 Original contains color illustrations (ISSN 0289-260X)

(NAL-SP-12; JTN-92-80307) Avail: CASI HC A04/MF A01

The following topics were discussed: research activities using CFD (Computational Fluid Dynamics); evolution and analysis of three dimensional boundary layer transition; computerized simulation; analysis of air flows around cylindrical bodies; the bullet trains; and an isolated surface roughness.

Author (NASDA)

N92-26907# Institute of Flow Research, Tokyo (Japan).

PATTERN SEARCH IN TURBULENT FIELD

HIROSHI SATO and TOSHIO OTAGURO *In NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition* p 1-2 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

In order to separate out an orderly moving flow from a turbulent flow, the application of wavelet analysis methods were presented. The wavelet method is an objective mathematical model, which is capable to extract a pattern from 'turbulent' conditions in natural and social phenomena without losing time dependent scale of disturbance distribution in the signal. In practice a wavelet function which has localized data in time axis is generated and an interrelation between this function and a given function is calculated. The time constant of the wavelet function is varied in order to interrelate with different time scales. In this report the velocity variance signals in the well developed turbulent boundary layer was analyzed by the wavelet analysis, and the calculated results were presented in the diagrams. These diagrams clearly exhibited diverse scale variations of the turbulent flow and time dependence of the variations, and this is the advantage of the wavelet method. Author (NASDA)

N92-26908# Ship Research Inst., Tokyo (Japan).

RESEARCH ACTIVITIES ON CFD AT THE SHIP RESEARCH INSTITUTE [SENPAKU GIJUTSU KENKYUSHO NI OKERU CFD KENKYU NO DOKO]

YOSHIKI KODAMA *In NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition* p 3-4 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The CFD (Computational Fluid Dynamics) method is used for the analysis of flow pattern in the area of ship fluid flow analysis. Research activities of the following themes utilizing the CFD method at the Ship Research Inst. were briefly described: viscous flow around the ship body, waves generated in free surface, the flow pattern around propellers, and interference between propellers and

ship stern by the accompanying flow. The CFD can be utilized with advantages for the numerical simulation under hypothetical flow patterns. As one example of CFD application, control of water flow around the ship body by magnetohydrodynamics was simulated. The Lorentz force is developed in the sea water, when electric current is applied under high magnetic field. This Lorentz force can be useful for the control of fluid field. Author (NASDA)

N92-26909# Tohoku Univ., Sendai (Japan). Faculty of Engineering.

THREE DIMENSIONAL BOUNDARY LAYER TRANSITION ON A YAWED CYLINDER [NANAME ENCHU NO SANJIGEN KYOKAISU SENI]

YASUAKI KOHAMA *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 5-9 Oct. 1990 *In* JAPANESE Original contains color illustrations

Avail: CASI HC A01/MF A01

The crossflow instability in three dimensional flow is influenced by sweepback angles of main wings and pressure distribution on wing surface. This crossflow instability is treated in two zones of pressure distribution on wing surface, one as a highly pressure decreasing zone at the front edge of wing and the other as a mildly pressure decreasing zone at other wing zone. In this paper, the criteria of crossflow instability generation and the turbulent flow transition process were analyzed using cylindrical model for the qualitative estimation of the strong pressure gradient of the crossflow instability. As for the aerodynamic heating process, the effects of transition zone on the heat conduction to the wall was investigated using heat sensitive liquid crystal. As the results of the investigation, in the transition zone where only primary instability emerged, the turbulent intensity was found not to increase and the heat conductivity to somewhat increase. Author (NASDA)

N92-26910# Osaka Univ. (Japan). Coll. of Engineering. **AN EVOLUTIONAL PROCESS OF THREE DIMENSIONAL DISTURBANCES IN LAMINAR BOUNDARY LAYERS [SANJIGEN KAKURAN NO HITOTSU NO HASSEI KATEI]**

MASAHITO ASAI *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 11-13 Oct. 1990 *In* JAPANESE

Avail: CASI HC A01/MF A01

As for the turbulent flow transition of boundary layer starting from the growth of a T-S (Tollmien-Schlichting) wave, the three dimensional wave configuration caused from the development of peak valley structure is one of the most important models. The turbulent flow transition of planar Poiseuille flow were investigated. As the results of experiments, the most probable cause of three dimensional wave formation were concluded to come from the distortion of main flow in the span direction. The synchronous three dimensional wave (a pair of oblique waves) is generated from the nonlinear interference of a two dimensional T-S wave with the three dimensional distortion part of the main flow. As the amplitude of the T-S wave increased over the threshold value of one percent, a synchronous three dimensional wave is predicted to develop from the two dimensional instability model. Experimental results were as follows: (1) the two dimensional T-S wave and three dimensional distortion of mean flow were given as the initial disturbance to Poiseuille flow and the timely development of the disturbance was numerically simulated using the Fourier Chebyshev spectrum method; and (2) as the amplitude of the T-S wave increased over the threshold value of one percent, the amplified three dimensional wave emerged. The amplification of the peak valley wave was confirmed to be caused from distortion of the main flow. Author (NASDA)

N92-26911# Railway Technical Research Inst., Tokyo (Japan). **AERODYNAMIC DRAG ON THE BULLET TRAINS [SHINKANSEN DENSHA NO KUKI TEIKO]**

TATSUO MAEDA *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 15-17 Oct. 1990 *In* JAPANESE

Avail: CASI HC A01/MF A01

The running resistance of electric trains can be divided into two resistances, one is the air resistance and the other is the mechanical resistance. The reduction of air resistance of high speed electric trains is especially important, as air resistance of trains increases faster than mechanical resistance in high speed. The air resistance of a long electric train like the 'Shinkansen' (Bullet Train) is evaluated as the combination of the pressure resistance which is exerted at the head and tail parts of the train and of the friction resistance which is exerted along side surfaces of the train and is proportional to the train length. The air resistance is measured from the difference of air resistance between long and short trains by the wind tunnel tests. The air friction resistance is measured from the pressure increase on the side surface of the train, when the train enters a tunnel. The combined resistance (air resistance and mechanical resistance) of the electric trains moving in the tunnel was measured and the resistance difference in and out of the tunnels were assumed to be the air resistance of the train. With this experiment, accuracies of measurement methods were analyzed. Author (NASDA)

N92-26912# National Aerospace Lab., Tokyo (Japan). **CONING MOTION AND FLAT SPINNING OF SLENDER BODIES AT HIGH ANGLES OF ATTACK [HOSONAGA BUTTAI NO DAIGYOKAKU KONINGU TO FURATO SUPIN NI TSUITE]**

TAKASHI YOSHINAGA and ATSUSHI TATE *In its* Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 19-21 Oct. 1990 *In* JAPANESE

Avail: CASI HC A01/MF A01

Slender bars with circular and rectangular cross sections often self-rotate in air flow. When an axisymmetrical bar is dropped in air, three different types of rotation are observed. In the beginning, the bar rotates about the axis perpendicular to the air flow and this rotation is called 'tumbling'. Next, the bar nutates about the axis parallel to the air flow and this nutation is called 'coning'. Finally, the bar rotates in the plane perpendicular to the air flow and this rotation is called 'flat spinning'. The 'flat spinning' phenomena in the critical Reynolds number range is discussed and applied to research for the analysis of flying bodies. The 'flat spinning' of a flying body is postulated as 'coning' in the high angle of attack and the cylindrical body of an aircraft is concluded to have a disadvantage for stability, as this body causes 'coning' motion in the high angle of attack. As for a rounded rectangular body, 'coning' motion is reduced in the range over the critical Reynolds number, but in the range under the critical Reynolds number range, the flying body becomes dynamically unstable as the effect of 'coning' motion. In the wind tunnel, the behavior of a slender cylinder with angles was investigated for its 'flat spinning' motions in the Reynolds number range of 3 to 6 x 10 (exp 5), and 'coning' motions were observed. Author (NASDA)

N92-26913# Nihon Univ., Tokyo (Japan). Coll. of Science and Engineering.

FLOW AROUND AN ISOLATED SURFACE ROUGHNESS IN THE LAMINAR BOUNDARY LAYER [KORITSU SODO MAWARI NO NAGARE NI TSUITE]

TATSUO MOTOHASHI *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 23-24 Oct. 1990 *In* JAPANESE

Avail: CASI HC A01/MF A01

The roughness of aircraft wings is an important factor for the air resistance of an aircraft. In order to reduce the air resistance, a method to keep boundary layers as laminar flow is often adapted. With this method, emergence of turbulent flow due to the roughness is not well understood. Especially when the roughness is somewhat large, strong disturbances are caused by the roughness, and turbulent flow occurs suddenly: the mechanism is not well understood. Experimental results in the air flow about isolated roughness (small stubs embedded on the boundary layer) were reported. The air about the isolated roughness were classified as three types according to the roughness: Reynolds number of about under 200, 200 to 500, and over 500. In the range of Reynolds number from 200 to 500, the air flow becomes unstable due to the interference of eddy flow and boundary layer and finally

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becomes turbulent flow. Diagrams on the air flow about roughness, equal turbulence lines, and equal shear strain line in the down flow of roughness (stubs) were shown. Author (NASDA)

N92-26914# Gifu Univ. (Japan).

EXPERIMENTAL STUDIES ON THE FLAT PLATE BOUNDARY LAYER TRANSITION USING HYDROGEN BUBBLE METHOD [HEIBAN KYOKAISU SENI NO SUISO KIHOKO NI YORU JIKKENTEKI KENKYU]

TATSUYA MATSUI, MUNESHIGE OKUDE, and NORIYASU ISHIDA /n NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 25-27 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The transition from laminar flow to turbulent flow in the flat plate boundary layer was studied. The flow pattern was visualized using the hydrogen bubble method and the velocity variable waveforms were measured using a heated wire flowmeter. Using the test results of the visualized flow pattern and velocity variable waveforms, the following three phenomena were analyzed: (1) the Tollmien-Schlichting (T-S) wave; (2) formation of high shear layer due to the development of lambda eddies and ejection and sweep; and (3) spikes developed in the velocity variable waveforms. In the first case, it was observed that the T-S wave can be represented by the visualized flow pattern. In the second case, the development of lambda eddy was continuously photographed with about four shots per second and the velocity variable waveforms perpendicular to the flat plate surface were shown. As the test results show, the large shear layers were observed between two legs of lambda eddies. In the third case, the air flow in the symmetrical plane of hairpin eddies was visualized by platinum wire perpendicular to the flat plate. At the same time, the continuous photographs and waveforms when a heated wire is placed in the upper and lower level with hairpin eddies were shown. The low velocity indicated downward and upward spike were observed. From test results, the interrelation between spike and hairpin eddies was clarified.

Author (NASDA)

N92-26915# National Research Lab. of Metrology, Tokyo (Japan).

APPLICATION OF RIBLET SURFACE TO PIPE FLOW [TEIKO GENSHO GIJUTSU NO KANNAIRYU HENO OYO NI TSUITE]

SHINICHI NAKAO /n NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 29-30 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The reduction of turbulent friction resistance to save energy consumption is important not only for aircrafts and ships but especially for pipelines' transportation of fluids. The following two turbulent friction resistance reduction technologies were applied for fluid flow in pipes: with flexible wall, and riblet. The experimental results and analysis are shown. In the experiment, a Teflon tube of 51 mm diameter and 0.05 mm thickness was used. The following three measurements were performed: (1) static axial pressure distribution in the pipe; (2) flow variables measurement by X type heated wire anemometer in the radial direction; and (3) vibration frequency and displacement in the pipe measurement by an eddy current displacement meter. The flow resistance increased at the Reynolds number of 10,000. The reason was attributed to the distortion of pipe wall due to the circumferential stress inequality when the tube was set. The resistance decreased about two percent at the Reynolds number of 30,000. This was due to a 0.25 mm increase in tube diameter. The test results were as follows: (1) the flow resistance was decreased about eight to ten percent; (2) the forms of grooves were V type or U type; and (3) the h+ of grooves was in the range of eight to 12 and s+ of grooves was ten to 20. (h is the height of grooves and s is the distance between grooves.) The riblet method is effective in reducing the surface friction resistance by etching longitudinal grooves on the wall surface. Author (NASDA)

N92-26916# Nihon Univ., Tokyo (Japan). Coll. of Science and Engineering.

NUMERICAL STUDIES ON LAMINAR TURBULENT TRANSITION AT THE STUTTGART UNIVERSITY, GERMANY [STUTT GART DAIGAKU NI OKERU SENI NO SUCHI KEISAN]

TATSUO MOTOHASHI /n NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 31-32 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The stability calculations of boundary layer on the flat plate are introduced. The stability calculations of boundary layer postulated the parallel flow without regard to the development of boundary layer. In order to exclude this postulate, the addition of disturbance to fundamental equation of flow was considered best, and the meanings of this method were summarized as follows: from the chart of Reynolds number and the dimensionless number of disturbance frequency, it was estimated that disturbances decreased in the stable zone and increased in the unstable zone. On the chart which showed the development of disturbance in the direction of flow at the dimensionless frequency of 1.316 for four time series, the disturbances were calculated to: decrease until it crossed a neutral curve, increase in the unstable zone, and decrease in the stable zone. Presently, the following research themes are studied: stability of two dimensional Poiseuille flow against finite disturbance, stability of exfoliate bubble flow, three dimensional analysis of a Tollmien-Schlichting (T-S) wave, flow pattern in grooves, etc. Author (NASDA)

N92-26917# Tohoku Univ., Sendai (Japan). Faculty of Engineering.

INVESTIGATION ON THE BOUNDARY LAYER TRANSITION OF ALTERNATELY OSCILLATING FLOW IN DECELERATION PHASE [KOBAN SHINDORYU GENSOKU ISO NI OKERU KYOKAISU SENI NO JIKKEN]

YU FUKUNISHI /n NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 33-34 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

The alternately oscillating flow in a duct transits to turbulent flow in the decreasing speed phase. This turbulent flow transition was studied experimentally using a heated wire flowmeter, and the results are reported. The oscillating flow develops a reverse pressure gradient in the decreasing speed phase and generates disturbance near the wall due to small exfoliation of laminar flow. It was observed that a three dimensional eddy structure forms locally disturbed zones and this eddy structure resembles the organizational structures which are found on the conditional extraction from the turbulent flow boundary layer of the flat plate. The experiment to observe the difference of the average configuration of the organizational vortex structure formed in the early phase and in the late phase were found to be caused by the deformation due to the time difference. The results of the experiment show that the structure configurations which exist in the early phase were either to disappear or to develop as it flows downward, and no general rule was concluded. In this experiment, the distinction between structures formed in the upper region and lower region was found to be difficult. In order to extract the characteristic of each structure, the wavelet analysis was applied to speed variation signal. Author (NASDA)

N92-26918# Meijo Univ., Nagoya (Japan). Faculty of Science and Technology.

VORTEX STRUCTURE IN WAKE OF A CIRCULAR CYLINDER [ENCHU HANRYUNAI NO UZURETSU NO KOZO]

MUNESHIGE OKUDE, KUNIHISA WADA, and TATSUYA MATSUI /n NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 35-37 Oct. 1990 In JAPANESE
Avail: CASI HC A01/MF A01

When the boundary layers of the flat plate, transition of shear flows like adjunct flow phenomena from laminar flow to turbulent flow and well-developed turbulent flow are visualized, the flow patterns with large and small eddies can be observed. In these

visualizations of flow patterns, the existence of eddies are described but usually the functions of eddy flows are seldom explained. One of the reasons is that the vortex structure in the flow are not well analyzed and often the vortex structure is so complex. As the vortex structure always exist in the transition process of flow, detailed analyses of vortex structure are desired. In this paper, the eddies in the vortex structure flows in the cylindrical adjunct flow at a Reynolds number of 140 was studied. The study covered the interrelation between vortex structure and velocity distribution in the cross sections of the adjunct flow obtained from heated wire anemometer and velocity variation and vortex structure distribution.

Author (NASDA)

N92-26919# Osaka Univ. (Japan). Coll. of Engineering.
CONTROL OF TURBULENT MIXING IN HYPERSONIC FLOW
[CHOONSOKU RANRYU KONGO NO SEIGYO]

MICHIO NISHIOKA *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 39-42 Oct. 1990 In JAPANESE

Avail: CASI HC A01/MF A01

The conventional engines for present supersonic aircrafts have a drawback in the subsonic flights: they generate strong shock waves, increase total pressure losses, dissociate gases due to increased temperature, and substantially decrease fuel burning efficiencies. When the gases are burned in the supersonic flow, duration times of gases in the combustion chamber become too short. The development of a new technology is required to mix rapidly fuel (hydrogen) and oxygen in the supersonic flow and burn them in time. Flow instability of the initial turbulent flow structure in the hypersonic shear layer is simulated as fuel injection, and the after flow (Mach number of 2.5) is analyzed using the linear stability theory and is studied on the amplified disturbances. The growth of this supersonic disturbance is observed using the Schlieren method. The method for additional mixing of gases is studied to accelerate disturbances.

Author (NASDA)

N92-26920# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF THE LAMINAR TURBULENT
TRANSITION IN A STRATIFIED FLOW [SEISORYU SENI NO
SUCHI SHIMYURESHON]

KIYOSHI YAMAMOTO *In its* Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 43-45 Oct. 1990 In JAPANESE

Avail: CASI HC A01/MF A01

The transition mechanism of heated laminar shear flow becomes more complex in comparison with no heating. For laminar shear flow, in addition to Reynolds number, Prandtl number and Rayleigh number (or Grashof number) are required to describe the flow conditions, or the boundary conditions of the flow have to be given as speed distribution and temperature distribution. Accordingly, the flow pattern changes irregularly with small differences of boundary conditions. The laminate effects of heating on the transition of laminar shear flow in the channel and in the rectangular duct were studied using numerical simulation. The results are given as follows. For the numerical simulation, the initial values problems of Navier-Stokes equations and energy equations are calculated using spectral method. The calculated results described the characteristics of the flow well. The numerical simulation was concluded to be useful for this type of analysis as the shear flow transition involves many parameters.

Author (NASDA)

N92-26921# Osaka Univ. (Japan). Coll. of Engineering.
RESPONSES OF BOUNDARY LAYERS TO STRONG
EXTERNAL DISTURBANCES [TSUYOI GAIRAN NI TAISURU
KYOKAISU NO OTO]

MASAHITO ASAI *In* NAL, Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 47-48 Oct. 1990 In JAPANESE

Avail: CASI HC A01/MF A01

The transition from laminar flow to turbulent flow of the boundary layer is an important phenomenon for various problems in astronautical engineering. When the turbulence in the flow is

weak, the boundary layer transition starts from the spatial amplification of a viscous T-S (Tollmien Schlichting) wave. The initial wave starts as a two dimensional wave and grows rapidly to a three dimensional wave with amplification. Finally, it corrupts to small scale hairpin eddies. The transitions starting from these wave amplifications are studied, and instability mechanisms are analyzed. In order to analyze the mechanism, the strength of turbulence (eddies) in the air flow that develops a transitional structure in the boundary layer and leads to a turbulent flow transition is analyzed. The responses of the boundary layers to the strong external disturbances are studied experimentally by introducing sonic wave which simulates hairpin eddies in the lower part of the front edge of a flat plate.

Author (NASDA)

N92-26922# National Aerospace Lab., Tokyo (Japan).
CROSS-FLOW INSTABILITIES AND PRESSURE GRADIENTS
IN BOUNDARY LAYERS [YOKONAGARE FUANTEI TO
ATSURYOKU KOBAI]

NOBUTAKE ITO *In its* Proceedings of the 5th and 6th Seminars on Investigation and Control of Boundary-Layer Transition p 49-51 Oct. 1990 In JAPANESE

Avail: CASI HC A01/MF A01

A three dimensional boundary layer is characterized by the velocity component normal to the external nonviscous flow, that is, by the existence of the transverse flow. One of the causes is the combination of the sweptback angle of the wings and the pressure gradient in the direction of a chord and the other is the pressure gradient in the direction of a wing width. Generally, these two phenomena coexist in the three dimensional boundary layer of the sweptback wings. The transverse flow velocity is represented as the sum of velocity components of the two transverse flows. The simple example of this general three dimensional boundary layer occurs when a wedge type body is placed with a yaw against uniform flow and the pressure gradient is applied to the direction of front edge of the body. The accurate solution for this type of three dimensional boundary layer equation and the linear stability calculation using the Orr-Sommerfeld equation are studied. The calculated results contain many unknown facts. It is shown that, if the pressure gradient in the direction of wing width is not considered, only a part of stability in the three dimensional boundary layer is observed and the most important characteristics are neglected.

Author (NASDA)

N92-26962# Tsukuba Space Center, Ibaragi (Japan).
UNIFIED COMPUTATIONAL METHOD FOR DESIGN OF FLUID
LOOP SYSTEMS

MASAO FURUKAWA *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 693-703 Dec. 1991

Avail: CASI HC A03/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Various kinds of empirical formulas of Nusselt numbers, fanning friction factors, and pressure loss coefficients were collected and reviewed with the object of constructing a common basis of design calculations of pumped fluid loop systems. The practical expressions obtained after numerical modifications are listed in tables with identification numbers corresponding to configurations of the flow passages. Design procedure of a cold plate and of a space radiator are clearly shown in a series of mathematical relations coupled with a number of detailed expressions which are put in the tables in order of numerical computations. Weight estimate models and several pump characteristics are given in the tables as a result of data regression. A unified computational method based upon the above procedure is presented for preliminary design analyses of a fluid loop system consisting of cold plates, plane radiators, mechanical pumps, valves, and so on.

ESA

N92-31256# National Inst. for Fusion Science, Nagoya (Japan).
STATISTICAL ANALYSIS OF ANOMALOUS TRANSPORT IN
RESISTIVE INTERCHANGE TURBULENCE

HIDEO SUGAMA and MASAHIRO WAKATANI (Kyoto Univ., Uji,

34 FLUID MECHANICS AND HEAT TRANSFER

Japan) Dec. 1991 27 p Submitted for publication
(ISSN 0915-633X)
(NIFS-125) Avail: CASI HC A03/MF A01

A new anomalous transport model for resistive interchange turbulence is derived from statistical analysis applying two-scale direct-interaction approximation to resistive magnetohydrodynamic equations with a gravity term. Our model is similar to the K sigma model for eddy viscosity of turbulent shear flows in that anomalous transport coefficients are expressed in terms of the turbulent kinetic energy K and its dissipation rate sigma, while K and sigma are determined by transport equations. This anomalous transport model can describe some nonlocal effects such as those from boundary conditions which cannot be treated by conventional models based on the transport coefficients represented by locally determined plasma parameters. Author

N92-33405# National Inst. for Fusion Science, Nagoya (Japan). **DENSITY-CARRYING PARTICLE METHOD FOR FLUID**
S. KAWATA (Nagaoka Technological Univ., Japan), M. SHIROMOTO (Nagaoka Technological Univ., Japan), and T. TEREMOTO (Nagaoka Technological Univ., Japan) Nov. 1991 28 p Sponsored in part by Ministry of Education and Culture (ISSN 0915-633X)
(NIFS-120) Avail: CASI HC A03/MF A01

A new particle method in which a numerical particle carries the density of physical quantities, is introduced and discussed in this paper. In the conventional particle-in-cell (PIC) method, particles do not carry the density of physical quantities but carry the mass, momentum, and energy. In order to simulate the large change in the physical quantities, it is necessary to change the particle size. However the change in the particle size in the conventional PIC method may lead an unphysical error, when it is applied inappropriately. Our particles carrying the density eliminate this unphysical error and can represent the large change in the physical quantities. One of example computations shows that in an adiabatic expansion the four figures of density change can be successfully simulated. Author

N92-33700# National Inst. for Fusion Science, Nagoya (Japan). **RELAXED STATE OF ENERGY IN INCOMPRESSIBLE FLUID AND INCOMPRESSIBLE MHD FLUID**
YOSHIOMI KONDOH (Gunma Univ., Maebashi, Japan) Dec. 1991 15 p
(ISSN 0915-633X)
(NIFS-123; DE92-514940) Avail: CASI HC A03/MF A01

Two examples of application of the general principle to find relaxed states are presented. These examples discuss results concerning the relaxed flow profile given by $\nabla \times \mathbf{u} = (\kappa) \mathbf{u}$ in the incompressible viscous fluid and the relaxed state given by $(\nabla \times \mathbf{B} = (\lambda) \mathbf{B})$ and $\nabla \times \mathbf{u} = (\kappa) \mathbf{u}$ in the incompressible viscous magnetohydrodynamic (MHD) fluid. The former result suggests that some common phenomena are expected to be observed in the reversed field pinch plasma and in the incompressible viscous fluid. The latter one is expected to have some connections with the field profile of B and the flow pattern of u in the magmas as a result of the earth dynamo. Author

N92-33862# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group. **PRELIMINARY REPORT ON FLUID EXPERIMENT BY TR-1A SOUNDING ROCKET**
HISAO AZUMA In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 131-140 21 Jan. 1992
Avail: CASI HC A02/MF A02

Five experiments were carried out to establish a experimental technology basis for fluid dynamics in space using the TR-1A rocket vehicle launched Sep. 1991. Observation of Marangoni flow and surface tension waves on a liquid silicone oil column and observation of the liquid column breaking down are conducted in microgravity conditions less than $10(\text{exp } -4)$ g. Images of transient Marangoni flow, steady Marangoni flow, and their surface velocity

distribution are obtained. Images of the breaking down of the liquid column are also obtained. And these agreed with the results of computerized simulation. Author (NASDA)

35

INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

A92-12316

OPEN RESONATOR FOR PRECISION DIELECTRIC MEASUREMENTS IN THE 100 GHZ BAND

B. KOMIYAMA, M. KIYOKAWA, and T. MATSUI (Communications Research Laboratory, Koganei, Japan) IEEE Transactions on Microwave Theory and Techniques (ISSN 0018-9480), vol. 39, Oct. 1991, p. 1792-1796. Research supported by Science and Technology Agency. refs
Copyright

Dielectric properties of fused silica, MgO, AlN, and BN were measured using an open resonator at frequencies around 100 GHz. The resonator is of the semifocal type and consists of a concave and a plane mirror, and the frequency variation method is used. To increase the reliability of measurement data, the operating frequency and thickness of the samples were chosen so as to make the parameter $\Delta = 1$ for every sample. The radius of curvature of the concave mirror is deduced with sufficient accuracy from the resonant frequencies of the transverse-electric-mode TEM_{0,0} and TEM_{1,0} modes, which results in a precise determination of resonator length. The standard deviation of measurements was less than 0.1 percent in permittivity and about 10 percent in loss tangent. I.E.

A92-13668

A PHOTON SCANNING TUNNELING MICROSCOPE USING AN ALGAAS LASER

SHUDONG JIANG, NAOYUKI TOMITA, MOTOICHI OHTSU (Tokyo Institute of Technology, Yokohama, Japan), and HISAOH OHSAWA (Nikon Corp., Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2107-2111. refs
Copyright

A novel super-resolution photon scanning tunneling microscope (PSTM) using diode lasers and optical fibers was demonstrated to measure the samples with submicron structure in a noncontact and nondestructive manner. A reproducible method for fabrication of the fiber probe with the tip curvature radius of 80 nm is reported. The step with the height of 9 nm, optical disk with submicron-sized pits similar to moth-eye structure, and latex particles with 80 nm in diameter have been observed. This is considered to be the smallest particle size resolved by the PSTM. Author

A92-14029

RESEARCH AND DEVELOPMENT PERTAINING TO PASSIVE FIBER-OPTIC GYROSCOPES

KAZUO HOTATE Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 464-472. In Japanese. refs

The characteristics of passive fiber-optic gyroscopes are described. Emphasis is placed on the interferometric fiber-optic gyroscope and the optical passive ring resonator gyroscope. Inertial navigation and coherent lightwave sensing are discussed. Y.P.Q.

A92-14030

A CLOSED-LOOP FIBER-OPTIC GYROSCOPE

AKIHIRO KUROKAWA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 473-477. In Japanese. refs

A closed-loop fiber-optic gyroscope with sawtooth phase

modulated feedback is described. Test results show the relationship between sawtooth phase modulation and scale factors, and the scale factor's stability is computed. Y.P.Q.

A92-15000

DETERMINATION OF THE CENTRAL POSITION OF ROTATION OF A ROTATING OBJECT BY LASER DOPPLER VELOCIMETRY

TOMOAKI EIJU and KIYOFUMI MATSUDA (Mechanical Engineering Laboratory, Tsukuba, Japan) Optical Engineering (ISSN 0091-3286), vol. 30, Nov. 1991, p. 1825-1830. refs
Copyright

New methods to determine the central position of rotation of a rotating object using LDV are described. The principle is based on the fact that the tangential velocity of the rotating object is proportional to the distance from the center of rotation, and that it can be measured by LDV with a microscope optical system. To realize this principle, three methods (angular and tangential velocity method, multiple-point method, and two-point method) are proposed. In the third method, a holographic optical element was used to play the role of multiple beamsplitter and a lens to obtain a rigid and simple optical system. From experimental results, it has been indicated that the position of the center of rotation is determined with an accuracy of 1 to 2 microns by these methods.

Author

A92-17448

IMAGE SENSOR OPERATING IN A PERSISTENCE-INTEGRATION MODE

ZHONG-SHOU HUANG and TAKAO ANDO (Shizuoka University, Hamamatsu, Japan) Applied Optics (ISSN 0003-6935), vol. 30, Nov. 10, 1991, p. 4636-4642. refs
Copyright

A novel solid-state image sensor based on a new charge integration concept is proposed. This sensor is suitable for imaging low-speed or static objects at low light levels. A model of the sensor as well as the experimental results of a single pixel device are presented. The dynamic range is about 110 dB. The linearity is about 0.71 at low-light levels. The signal gain of the device can automatically increase with a decrease of incident light power.

Author

A92-17571

IN SITU MONITORING OF SURFACE KINETICS IN GAAS ATOMIC LAYER EPITAXY BY SURFACE PHOTO-ABSORPTION METHOD

AKINORI KOUKITU, HITOSHI IKEDA, HIROSHI SUZUKI, and HISASHI SEKI (Tokyo University of Agriculture and Technology, Koganei, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Oct. 1, 1991, p. L1712-L1714. refs
(Contract MOESC-03243211)
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A92-18927

IN SITU GRAVIMETRIC MONITORING OF THE GAAS GROWTH PROCESS IN ATOMIC LAYER EPITAXY

AKINORI KOUKITU, HITOSHI IKEDA, HIROSHI YASUTAKE, and HUSASHI SEKI (Tokyo University of Agriculture and Technology, Koganei, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1847-L1849. refs
(Contract MOESC-03243211)
Copyright

A gravimetric method for in situ monitoring of atomic layer epitaxy (ALE) is proposed and applied to the growth of GaAs by halogen transport ALE. An ALE growth system with an electrobalance is developed as a monitoring system. In the conventional method of measurement the growth rate of ALE is obtained as an average value, but the system can directly monitor the growth rate and the surface coverage in each cycle in actual ALE growth conditions. It is shown that the growth of the monomolecular layer unit occurs in each cycle in halogen transport GaAs ALE, and the gravimetric method makes in situ and real-time

monitoring of growth rate possible on a submonolayer scale.

Author

A92-19805

IMAGE PROCESSING TECHNIQUE OF FRACTURE SURFACE

K. KOMAI (Kyoto University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1963-1972. refs
Copyright

A computer aided image processing and pattern recognition technique has been applied to quantitative fracture surface analysis. An automated computation of two-dimensional parameters and three-dimensional reconstruction of fracture surfaces became possible with sufficient precision.

Author

A92-20198

BIASED PERFORMANCE OF HIGH-LOW JUNCTION ROOM TEMPERATURE 10.6 MICRONS SENSOR

KAZUO KIKUCHI (National Defense Academy, Yokosuka, Japan) Infrared Physics (ISSN 0020-0891), vol. 31, no. 6, 1991, p. 555-559. refs
Copyright

High-low junction 10.6 microns detectors are fabricated from p-type Ge. These detectors operate as room temperature photo-voltaic detectors. The d.c. bias-voltage dependence of their output voltage shows two different characteristics; one is a micro-type photoconductivity effect and the other is a new phenomenon. An improvement of responsivity of more than 12dB was obtained by using the new effects.

Author

A92-21708

A NOVEL METHOD FOR SUPERCONDUCTING ENERGY GAP MEASUREMENT

KOICHI MIZUSHIMA, SHINJI INOUE, MASAYUKI SAGOI, and JIRO YOSHIDA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 15, 1991, p. L1927-L1930. Research supported by New Energy and Industrial Technology Development Organization of Japan. refs
Copyright

A novel method has been developed for the measurement of the superconducting energy gap in high-temperature superconductors. The energy gap was measured by detecting the quasi-particle current through an SNS' junction, where S and S' are a high-temperature and a conventional superconductor, respectively. The advantage of this method over conventional tunneling spectroscopy lies in its applicability to superconductors with a degraded surface. A clear gaplike structure with a gap energy of 16 mV was observed for YBCO.

Author

A92-21731

ESTIMATION OF FREQUENCY ACCURACY AND STABILITY IN A DIODE LASER-PUMPED RUBIDIUM BEAM ATOMIC CLOCK USING A NOVEL MICROWAVE RESONANT METHOD

HIROYUKI FURUTA and MOTOICHI OHTSU (Tokyo Institute of Technology, Yokohama, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Nov. 1991, p. 2921-2931. refs
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A92-24094

PROXIMITY SENSOR USING A SPIRAL-SHAPED LIGHT-EMITTING MECHANISM

TOKUJI OKADA (Niigata University, Japan) and ULRICH REMBOLD (Karlsruhe, Universitaet, Federal Republic of Germany) IEEE Transactions on Robotics and Automation (ISSN 1042-296X), vol. 7, Dec. 1991, p. 798-805. Research supported by Alexander von Humboldt-Stiftung. refs
Copyright

A proximity sensor is presented in which light is cast from a source point on an object through a slit cut in a rotating disk. The

35 INSTRUMENTATION AND PHOTOGRAPHY

light passing through the slit is reflected onto the object's surface. Some of the reflected light is captured by a photodiode with the time period being recorded. The distance is determined from the function of the slit's shape and the time period when the photodiode captures the reflected light. The light-emitting mechanism makes it possible to measure the distance of an object repetitively. The distance measurement is neither affected by environmental illumination nor by attributes of the object such as diffusibility or reflectivity as far as there is light to reach the photodiode. Two profiles of the slit are discussed. One allows for easy fabrication and the other simplifies signal processing. The validity of the measurement concerning the two profiles is shown by experimental results. I.E.

A92-24598

EVALUATION OF HOT-WIRE MEASUREMENTS IN WALL SHEAR TURBULENCE USING A DIRECT NUMERICAL SIMULATION DATABASE

YUJI SUZUKI and NOBUHIDE KASAGI (Tokyo, University, Japan) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, Jan. 1992, p. 69-77. refs (Contract MOESC-02302043) Copyright

An error analysis for hot-wire/film measurements in wall shear turbulence was performed using a direct numerical simulation database of turbulent channel flow. Fairly complete models of single- and dual-sensor probes were considered so that the effects of spatial resolution as well as neglected velocity components were investigated quantitatively. It was found that the values measured near the wall should be primarily dependent upon the sensor spacing; that is, wall-normal and spanwise turbulent intensities were overestimated markedly, whereas streamwise intensity was slightly underestimated. These errors proved to be caused by strong anisotropy as well as fine scales of the near-wall turbulence. A correction method using two-point correlation functions is also presented. These analytical results were confirmed by a physical experiment with an X-array hot-film probe. Author

A92-26515

TEST OF TWO-DIMENSIONAL POSITION SENSITIVE SILICON DETECTOR FOR COSMIC RAY TELESCOPE BY A LIGHT PULSER

CHIHIRO KATO, AKIRA YONEDA (Institute of Physical and Chemical Research, Wako, Japan), KAZUOKI MUNAKATA (Shinshu University, Matsumoto, Japan), TAKASHI IMAI, and TSUYOSHI KOHNO (Institute of Physical and Chemical Research, Wako, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3549, 3550. refs Copyright

In order to measure the distortion pattern of a large 2D position-sensitive silicon detector a simple method is investigated which incorporates a light pulser instead of high-energy particles from an accelerator. The obtained distortion pattern is quite similar to that from accelerator beams. It is concluded that a light pulser can be used for this measurement. This simple method is relatively easy considering the tight accelerator machine-time. Author

A92-26529

HYDROGEN DETECTION BASED ON COLORATION OF ANODIC TUNGSTEN OXIDE FILM

K. ITO and T. OHGAMI (Shinshu University, Nagano, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 24, 1992, p. 938-940. refs (Contract MOESC-01460138) Copyright

The paper describes a novel method for detecting hydrogen on the basis of a coloration of a very thin palladium overlayer-anodic oxide film-tungsten sheet structure whose optical reflectance is modulated by the presence of hydrogen in the ambient gas. The effect is due to the free electron modulation of optical constants of the anodic oxide film. It is a prerequisite that the oxide film has the composition WO₃-H₂O. I.S.

A92-26585

REAL-TIME PROCESSOR FOR STELLAR SPECKLE INTERFEROMETRY USING MICROCHANNEL SPATIAL LIGHT MODULATOR

JUNJI OHTSUBO, TAKESHI UTAKOUJI (Shizuoka University, Hamamatsu, Japan), TAMIKI TAKEMORI, KATUYOSI FUJITA (Hamamatsu Photonics, Hamakita, Japan), and SYUZO ISOBE (National Astronomical Observatory, Mitaka, Japan) IN: Optical information-processing systems and architectures II; Proceedings of the Meeting, San Diego, CA, July 9-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 450-459. refs Copyright

To obtain the averaged Fourier power spectrum of a time-varying stellar speckle images from a binary star a portable real-time Fourier-transform processor is developed for stellar speckle interferometry, in which the Fourier transform of the image is done optically by using a microchannel spatial light modulator. Several double star images are analyzed on the telescope sites by the real-time processor. The cycle time of 2-10 Hz is achieved in this instrument depending upon incoming light level. Author

A92-30555

MEASUREMENT OF TEMPERATURE AND VELOCITY DISTRIBUTION BY A LONG HOT-WIRE

E. MORISHITA (Tokyo, University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 208-211. In Japanese. refs

A long hot-wire anemometer is used for temperature and velocity distribution measurement. Results of numerical analysis and experimental studies are presented. Y.P.Q.

A92-31572

VIBRATION DAMPING MECHANISMS WITH GYROSCOPIC MOMENT

OSAMU NISHIHARA, HIROSHI MATSUHISA, and SUSUMU SATO (Kyoto University, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, March 1992, p. 50-55. refs Copyright

Damping mechanisms based on gyroscopic moments are studied and their characteristics are compared with conventional mechanisms. A generalized form of Schlick's gyroscope is theoretically analyzed, and an optimal design method is derived. The stabilizing effect is compared with the rotational dynamic vibration absorber. It turns out that the effect of the passive gyroscopic stabilizer depends on the rotating speed of the gyroscope; thus the stabilizer has no essential limitation by the inertial moment such as there is with the rotational dynamic vibration absorber. The gimbal movement of the CMG (control moment gyroscope) is directly controlled with an actuator, thus it can be used as a fully active vibration control mechanism. The single-gimbal CMG is compared with the RW (reaction wheel) with respect to the damping efficiency for impulsive disturbances. Experiments with a single-gimbal CMG for a pendulum are carried out and the results prove the efficiency. Author

A92-32503

ERROR ANALYSIS OF TURBULENT FLOW MEASUREMENTS WITH X-PROBES

YASUTAKA NAGANO, TOSHIHIRO TSUJI, and MASATO TAGAWA Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2590-2596. In Japanese. refs

Inevitable errors in X-probe measurement are investigated in simulated Gaussian velocity fields generated on a digital computer. Two types of X arrangements are studied: one is a conventional X-probe comprised of two slant hot wires, and the other is that which consists of slant and normal hot wires (modified X-probe). The numerical simulation results indicate that the most significant factor producing measurement errors is the difference in an instantaneous velocity field between two wires. The measurement

accuracy of the modified X-probe depends strongly on the effect of wire separation. To confirm the error analysis, turbulent quantities in a pipe flow are measured using these X-probes. Author

A92-32505

DEVELOPMENT OF A METHOD OF TEMPERATURE MEASUREMENT IN THE RAREFIED GAS FLOW USING THE VISUALIZED IMAGES BY LIF - TEMPERATURE MEASUREMENT USING TWO LASER BEAMS WITH DIFFERENT WAVELENGTH

TOMOHIDE NIIMI, TETSUO FUJIMOTO, KUNIKAZU KONDO, and NORIHIRO SHIMIZU Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2608-2615. In Japanese. refs

A method is developed for local temperature measurement in the rarefied gas flow using laser-induced fluorescence of iodine molecules seeded in carrier gas. Iodine molecules have many absorption lines in the visible region and radiate intense fluorescence. The fluorescence intensity is proportional to the number of molecules in the energy level excited by the laser beam. From the dependence of this number on the temperature, the local temperature can be decided through the ratio between the fluorescence intensities of two visualized images which are obtained by irradiations of laser beams with different wavelength. This method allows the measurement of the temperature distribution of the entire flowfield instantaneously by means of a laser sheet and a sensitive vidicon camera. This method is applied to the local temperature measurement of the flowfield of a supersonic free jet in which temperature varies drastically. It is found that the temperature distribution along the centerline of the jet measured by two absorption lines agrees well with the theoretical one. Author

A92-32506

THREE-DIMENSIONAL FLOW VISUALIZATION OF SHOCK WAVE USING DOUBLE-PULSED HOLOGRAPHIC INTERFEROMETRY. I - THREE-DIMENSIONAL MEASUREMENT OF SHOCK WAVE CONFIGURATION GENERATED FROM THE FLYING U-SHAPED PIN IN A SUPERSONIC FLOW AND ITS DATA PROCESSING

TAKAO KASHIWAGI and SHOHACHI YASU Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2616-2625. In Japanese. refs

A92-32507

THREE-DIMENSIONAL FLOW VISUALIZATION OF SHOCK WAVE USING DOUBLE-PULSED HOLOGRAPHIC INTERFEROMETRY. II - FLOW VISUALIZATION FOR THREE-DIMENSIONAL SHOCK STRUCTURES IN ROTATING AEROENGINE FAN BLADE ROWS

SHOHACHI YASU, TEIICHI TAMAKI, SUSUMU NAGANO, and TAKAO KASHIWAGI Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2626-2633. In Japanese. refs

The growing demand for more fuel-efficient aero gas turbine engines has led to the need for a detailed understanding of the aerodynamic behavior of components. The optical technique of holography has recently achieved importance as a means of providing the experimental data necessary for the development and validation of relevant design calculation methods. This paper describes the double-pulsed holographic flow visualization technique which has been developed at IHI and provides information on 3-dimensional shock structures of the transonic flow region between the blades and shock/casing wall boundary layer interaction in rotating aeroengine fan at various rotor speeds and throttling conditions. Author

A92-33977

RULING ENGINE USING A PIEZOELECTRIC DEVICE FOR LARGE AND HIGH-GROOVE DENSITY GRATINGS

TOSHIKI KITA and TATSUO HARADA (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) Applied Optics (ISSN

0003-6935), vol. 31, April 1, 1992, p. 1399-1406. refs Copyright

A ruling engine for large and/or high-groove density gratings is developed. A hybrid driving method that uses a piezoelectric device and a screw-nut mechanism is adopted to achieve stop-and-go blank motion with a closed-loop control system. Several test gratings, including a ruled area of 300(width) x 200(groove length) sq mm, groove densities of 6000 and 10,000 grooves/mm, and a uniform and varied-line space, are ruled to confirm the basic functions of the ruling engine. A set of four spherical, varied-line-space gratings with central groove densities of 6000, 4550, 3450, and 2616 grooves/mm and a ruled area of 200 x 200 sq mm is ruled for the orbital retrievable far and extreme ultraviolet spectrometer. Author

A92-35075

CHANGE DETECTION FROM REMOTELY SENSED MULTI-TEMPORAL IMAGES USING SPATIAL SEGMENTATION

HIROSHI HANAIZUMI, HIROSHI OKUMURA (Hosei University, Koganei, Japan), and SADA O FUJIMURA (Tokyo, University, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1079-1082. refs Copyright

A new method is proposed for detection of temporal change between remotely sensed multispectral images. This method uses regression and segmentation techniques for reduction of apparent change due to noise and/or variation of recording gain and offset between two images. In the method, the images are normalized by fitting a line to the whole pixel scattergram between them. A description is presented of the principle and the procedures of this method. The validity of this method is confirmed by numerical simulation. A result obtained by application of this method to a pair of actual multitemporal multispectral images is also shown. I.E.

A92-35899

SOLID ELECTROLYTE CARBON DIOXIDE SENSOR USING SODIUM-ION CONDUCTOR AND Li2CO3-BACO3 ELECTRODE

SHENG YAO, YUICHI SHIMIZU, NORIO MIURA, and NOBORU YAMAZOE (Kyushu University, Kasuga, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L197-L199. Research supported by MOESC and Iketani Science and Technology Foundation. refs Copyright

A92-35900

SINGLE-SHOT MEASUREMENT OF SPECTRAL REFLECTANCE OF A SOFT X-RAY MULTILAYER MIRROR USING A LASER-PLASMA X-RAY SOURCE

HIROZUMI AZUMA, YOSHIHIDE WATANABE (Toyota Central Research and Development Laboratories, Inc., Aichi, Japan), YOSHIKI KATO (Osaka University, Suita, Japan), TOMOYOSHI MOTOHIRO, SHOJI NODA (Toyota Central Research and Development Laboratories, Inc., Aichi, Japan), and KENSUKE MURAI (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L203-L205. refs (Contract MOESC-01651008)

Copyright

A new experimental arrangement is proposed to measure spectral reflectance of multilayer coatings in the soft X-ray region in a single laser shot, where laser-produced plasma is used as a light source. Reflectivity measurement of a Mo/Si multilayer having a 2d spacing of 24 nm is presented. Author

A92-36561

AUTOMATIC MEASUREMENT OF THE ARRIVAL DIRECTION OF WHISTLERS [AVTOMATICHESKOE IZMERENIE NAPRAVLENIYA PRIKHODA SVISTIASHCHIKH ATMOSFERIKOV]

K. OHTA (Chubu University, Kasugai, Japan) and M. HAYAKAWA

35 INSTRUMENTATION AND PHOTOGRAPHY

(Nagoya University, Toyokawa, Japan) Geomagnetizm i Aeronomiia (ISSN 0016-7940), vol. 32, no. 1, Jan.-Feb. 1992, p. 34-41. In Russian. refs
Copyright

A fully automated system for recording the arrival direction of whistlers is described which uses observations of horizontal magnetic and vertical electric components of the wave field. A signal from three antennas at two selected frequencies is digitized by an ADC and stored in its temporary memory until a signal identified as the whistler arrives at the antenna input. The information is then transferred to a microcomputer. The wave arrival direction and polarization are determined through measurement of the ratio of the amplitudes and phase difference of the magnetic components to the vertical electric component. An example of data analysis using this technique is presented. L.M.

A92-38459

EVALUATION OF X-PROBE RESPONSE TO WIRE SEPARATION FOR WALL TURBULENCE MEASUREMENTS

M. TAGAWA, T. TSUJI, and Y. NAGANO (Nagoya Institute of Technology, Japan) Experiments in Fluids (ISSN 0723-4864), vol. 12, no. 6, April 1992, p. 413-421. refs
Copyright

Inevitable errors in X-probe measurement are investigated in simulated Gaussian velocity fields generated on a digital computer. Two types of X arrangement are studied: one is a conventional X-probe comprised of two inclined hot wires, and the other consists of inclined and normal hot wires (modified X-probe). The computer simulation results under typical wall-turbulence conditions indicate that the most significant factor producing measurement errors, in both high and low intensity turbulence, is the difference between the instantaneous velocities sensed by the two wires, associated with wire separation. In particular, the measurement accuracy of the modified X-probe depends greatly on the effect of wire separation, and at worst, data obtained with such a probe result in fallacious information. To confirm the error analysis, turbulent quantities in a pipe flow were measured using these X-probes. The experimental results are consistent with the results of the error analysis. Also, based on the present analysis, simple formulas have been developed to estimate inherent errors in X-probe measurements. Author

A92-40261

COMMON PATH HETERODYNE OPTICAL FIBER SENSORS

TOSHIHIKO YOSHINO (Gumma University, Kiryu, Japan), TAKAHARU HASHIMOTO (Tokyo Sokki Kenkyujo Co., Ltd., Kiryu, Japan), MAKOTO NARA (Nikon Corp., Yokohama, Japan), and KIYOSHI KUROSAWA (Tokyo Electric Power Co., Inc., Japan) Journal of Lightwave Technology (ISSN 0733-8724), vol. 10, no. 4, April 1992, p. 503-513. Research supported by MOESC. refs
Copyright

The common path type of differential heterodyne fiber-optic sensing scheme has been developed which uses a polarization maintaining fiber as either a sensor or an optical lead and a dual-frequency dual-polarization laser beam. The sensing schemes are applied to the measurements of temperature, strain, force, pressure, rotation rate (gyro), magnetic and electric fields, and thin film thickness. The sensing scheme and main performances for each measurand are described. High precision and high stability as well as good linearity for each measurand are demonstrated. Author

A92-41292

METHOD FOR VISUALIZING STREAMLINES AROUND HYPERSONIC VEHICLES BY USING ELECTRICAL DISCHARGE

MASATOMI NISHIO (Fukuyama University, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1662, 1663. refs

Copyright

A method for visualizing hypersonic vehicle streamlines via electrical discharge has been devised and demonstrated in the case of a wedge and a wedge with a two-dimensional rectangular

afterbody. This method becomes increasingly difficult to apply at smaller Mach numbers, however, in virtue of its dependence on the strength of the shocks generated in the flow. The visualization of multiple streamlines is possible if pulsed voltage is repeatedly applied during the electric discharge. O.C.

A92-41293

SIMPLE METHOD FOR DETERMINING THE LASER-VELOCIMETER FOCAL POINT WITH THE AID OF A HOT-WIRE ANEMOMETER

SHOHEI TAKAGI (National Aerospace Laboratory, Chofu, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, no. 6, June 1992, p. 1664, 1665. refs

Copyright

A technique is proposed that uses a hot-wire anemometer to ascertain the exact focal-point location of a laser velocimeter along the beam axis. The focal-point separation of the two laser beams of a laser-transit anemometer system was measured; the technique is shown to entail only modest laser-beam power for focal-point detection, relative to that needed for velocity measurement. The method can be extended to the evaluation of such other laser-beam parameters as power, beam separation, diameter, etc. O.C.

A92-41600

STARK PHASE SHIFT AND DEFLECTION IN THE ULTRACOLD ATOMIC INTERFEROMETER

FUJIO SHIMIZU (Tokyo, University, Japan), KAZUKO SHIMIZU, and HIROSHI TAKUMA (University of Electro-Communications, Chofu, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L436-L438. Research supported by MOESC. refs

Copyright

An atomic interferometer is a tool for measuring rotation and acceleration with extremely high phase sensitivity. This paper presents results of an investigation of the phase shift and deflection of interference patterns induced by a static electric field in an optically cooled ^3S metastable Ne interferometer with Young's double-slit configuration (described by Shimizu et al., 1991), using a specially designed experimental setup. To obtain the velocity-resolved interference pattern, the time-resolved measurement was carried out by pulsing the two lasers used in the setup and, at the same time, recording the CCD picture of the spots on video tape. Results show that the phase shift of the interferometer was about 2π at 300 V, and the deflection angle of atoms was about 5×10^{-3} rad with dE square/dz of about $10 \exp 4$ V square/mm. I.S.

A92-44331

VISUALIZATION OF ROLL-CELL STRUCTURE IN TURBULENT WALL JETS ALONG A STRONGLY CONCAVE SURFACE

N. FUJISAWA (Gumma University, Kiryu, Japan) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 1, May 1992, p. 70-72. refs

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A92-45139

FOCUSING OF SHOCK WAVES IN WATER AND ITS OBSERVATION BY THE SCHLIEREN METHOD

KOJI ISUZUGAWA, MAKOTO HORIUCHI, and YOSHIYUKI OKUMURA (Osaka Prefecture University, Sakai, Japan) IN: International Congress on High-Speed Photography and Photonics, 19th, Cambridge, England, Sept. 16-21, 1990, Proceedings. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 1003-1010. refs

Copyright

A spherical shock wave is generated by one spark discharge between electrodes at the first focal point of a rotationally symmetrical semiellipsoid, a part of the spherical wave reflects from the semiellipsoid, and produces a high pressure near the second focal point. This characteristic is used for the extracorporeal shock wave lithotripter. However, there are some points to be made clear, such as the mechanism of shock wave generation and the process of its reflection and focusing. In this study, as

the first step, visualizing the behavior of the shock wave is tried by means of the schlieren system using an iris instead of the knife edge. Especially in order to make the aspect of reflection clear, cylindrical shock waves generated by underwater wire explosions are used with an elliptical reflector. Photographs are taken with the image converter camera 'IMACON 790', and as the result the whole process from the generation to the focusing of the shock wave is clearly shown. Author

A92-45269

APPLICATION OF FLOW VISUALIZATION TECHNIQUE TO SUPERFLOW EXPERIMENT

NAOIKI ICHIKAWA (Mechanical Engineering Laboratory, Tsukuba, Japan) and MASAHIDE MURAKAMI (Tsukuba, University, Japan) IN: High Reynolds number flows using liquid and gaseous helium. New York, Springer-Verlag, 1991, p. 209-214. refs
Copyright

A tracer method based on hydrogen-deutrium solid particles and hollow glass spheres is applied to He II flow visualization. The latter was used to investigate thermal counter flow jet and large scale vortex rings. O.G.

A92-45270

LASER DOPPLER VELOCIMETER APPLIED TO SUPERFLOW MEASUREMENT

MASAHIDE MURAKAMI, T. YAMAZAKI, A. NAKANO, and H. NAKAI (Tsukuba, University, Japan) IN: High Reynolds number flows using liquid and gaseous helium. New York, Springer-Verlag, 1991, p. 215-221. refs
Copyright

The application of a Laser Doppler velocimeter (LDV) to He II flow measurement was attempted for sufficiently high accuracy and resolution in both time and space. The detail of the application technique and some results measured with the LDV for the thermal counterflow jet are described here to demonstrate the applicability of an LDV as major diagnostic means for the He II flow facility. Author

A92-47825

STUDY OF A PRESSURE MEASUREMENT METHOD USING LASER IONIZATION FOR EXTREMELY-HIGH VACUUM

KIYOHIDE KOKUBUN Electrotechnical Laboratory, Researches (ISSN 0366-9106), no. 933, Dec. 1991, 77 p. In Japanese. refs

A method for measuring pressure in extremely-high vacuum (XHV) by laser ionization by means of highly sensitive ion-detection systems was developed. For this purpose, the characteristics of nonresonant multiphoton ionization of rare gases, XeCl, KrF, and ArF were investigated. It was found that, to measure pressures in the range of XHV, an ion detection system must be able to count accurately a few individual atoms or molecules. Two such systems were developed and fabricated: one based on the pulse-counting method, and the other using the image-processing technique. An XHV system was fabricated which was able to attain pressures lower than $10 \exp -10$ Pa. I.S.

A92-48374

DEVELOPMENT OF HIGH-SENSITIVITY AND LOW-NOISE INTEGRATED ACOUSTIC EMISSION SENSOR

MITSU HARU SHIWA (Tokyo, University, Japan), HIDEHIRO INABA (Fuji Ceramics Co., Fujinomiya, Japan), STEVE H. CARPENTER (Denver, University, CO), and TERUO KISHI (Tokyo, University, Japan) Materials Evaluation (ISSN 0025-5327), vol. 50, no. 7, July 1992, p. 868-874. refs
Copyright

A high-sensitivity and low-noise AE piezoelectric sensor has been developed. From analysis of the piezoelectric element, it is determined that maximum sensitivity is obtained when the resonant frequency of the radial expansion mode is equal to the resonant frequency of the thickness expansion mode. It is indicated that elimination of the signal cable between the piezoelectric element and the preamplifier reduced both the noise level and the loss of signal from the piezoelectric element. R.E.P.

A92-50045

FREQUENCY RESPONSE AND INSTANTANEOUS TEMPERATURE PROFILE OF COLD-WIRE SENSORS FOR FLUID TEMPERATURE FLUCTUATION MEASUREMENTS

T. TSUJI, Y. NAGANO, and M. TAGAWA (Nagoya Institute of Technology, Japan) Experiments in Fluids (ISSN 0723-4864), vol. 13, no. 2-3, 1992, p. 171-178. refs
Copyright

The information of the wire response is necessary for the estimation of corrections and uncertainty of temperature measurements. This paper describes the theoretical response of cold-wire sensors to temperature fluctuations in a fluid flow. Existing transfer functions of cold wires are approximate and implicit functions of frequency. The exact solutions of heat conduction equations for a cold wire and stubs are presented taking account of the prong effect. Because the solutions have simple forms of elementary functions, the frequency response of cold wires is easily calculated. Sample calculations are given under several typical conditions. Also, the instantaneous temperature profiles of a cold wire are obtained for the first time. Author

A92-50328

QUALITATIVE MODEL FOR VISUALIZING SHOCK SHAPES

MASATOMI NISHIO (Fukuyama University, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, no. 9, Sept. 1992, p. 2346-2348. refs
Copyright

A qualitative theory of the visualization has been established by considering the relation among the radiation intensity from the electric discharge, the gas molecular number density, and the excitation function vs electron energies. It was found that by applying this qualitative theory of the visualization, the most suitable experimental condition exists. R.E.P.

A92-50396

SCANNING WIENER-FRINGE MICROSCOPE WITH AN OPTICAL FIBER TIP

NORIHIRO UMEDA, YUHTTEKI HAYASHI, KEIJI NAGAI, and ATSUO TAKAYANAGI (Tokyo University of Agriculture and Technology, Koganei, Japan) Applied Optics (ISSN 0003-6935), vol. 31, no. 22, Aug. 1, 1992, p. 4515-4518. Research supported by Murata Science Foundation. refs
Copyright

A scanning probe optical microscope using the Wiener fringe is presented. The Wiener fringe is formed by a standing wave between the incident and reflected waves on an optically reflective surface and is detected by inserting an optical fiber tip into the fringe-field region. The detected signal is used to maintain the tip-sample distance constant so that a topographic image of a sample can be obtained by a computer-assisted instrument. A spatial resolution of 200 nm has been achieved by observing a sample of known geometry. Author

A92-51145

FINITE-ELEMENT SIMULATION OF TRANSIENT HEAT RESPONSE IN ULTRASONIC TRANSDUCERS

EI'ICHI ANDO (SPC Electronic Corp., Chofu, Japan) and YUKIO KAGAWA (Okayama University, Japan) IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (ISSN 0885-3010), vol. 39, no. 3, May 1992, p. 432-440. refs
Copyright

The application of the finite-element method to a transient heat response problem in electrostrictive ultrasonic transducers during their pulsed operation is described. The temperature and thermal stress distribution are of practical importance for the design of the ultrasonic transducers when they are operated at intense levels. Mechanical vibratory loss is responsible for heat in the elastic parts while dielectric loss in the ferroelectric parts. A finite-element computer model is proposed for the temperature change evaluation in the transducers with time. Natural and forced cooling convection and heat radiation from the transducers' boundaries are included. Simulation is made for Langevin-type transducer models, for which comparison is made with experimental data. Author

A92-51641

THREE-DIMENSIONAL RECONSTRUCTION OF SOLID MODELS FROM MULTI-DIRECTIONAL IMAGES AND APPLICATIONS TO INDUSTRIAL MENSURATION

JUNTA DOI, KAZUO KOEDA (Tokyo, University, Japan), and TETSUO MIYAKE (Asahi Glass Co., Ltd., Central Research Laboratory, Yokohama, Japan) IN: Close-range photogrammetry meets machine vision; Proceedings of the Meeting, Zurich, Switzerland, Sept. 3-7, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 564-571. refs Copyright

Multidirectional image inputs are presently used as the basis of an automated modeling system representing an object body by means of a solid model of polyhedral approximation. Solid-model generation proceeds from the calculation of viewing pyramids that consist of the image boundary and the corresponding focal point. Attention is given to the results thus obtained for a variety of noncontacting, 3D shape measurements of irregular, complex objects, as well as for automated mesh generation in the boundary element analysis of a lemon, CAD of a tillage blade, and the aerodynamic behavior of various flow-visualization media. O.C.

A92-52822

PLANAR MEASUREMENT OF TEMPERATURE IN RAREFIED GAS FLOWS BY LIF IMAGES

TOMOHIDE NIIMI, TETSUO FUJIMOTO, and NORIHIRO SHIMIZU (Nagoya University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 1482-1489. Research supported by MOESC. refs Copyright

A method for planar measurement of temperature in rarefied gas flow by means of two-line laser-induced iodine fluorescence is proposed. Temperature is determined from the ratio of the intensities of fluorescence, which are obtained by irradiation of two laser beams of different wavelengths. The use of a laser sheet and a high-sensitivity vidicon camera allows multiple-point measurements of temperature in the flowfield. The effectiveness of this method is verified by its application to the determination of the temperature distribution of a supersonic free jet. Author

A92-53677

A PULSE SHAPE DISCRIMINATOR AND AN ONLINE SYSTEM FOR THE BALLOON-BORNE HARD X-RAY/GAMMA-RAY DETECTOR

T. TAKAHASHI, T. KAMAE, M. TANAKA, S. GUNJI, S. MIYAZUKI, T. TAMURA, Y. SEKIMOTO, N. YAMAOKA (Tokyo, University, Japan), J. NISHIMURA, N. YAJIMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) et al. IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1619-1626. refs Copyright

Attention is given to a new kind of phoswich counters (the well-type phoswich counter) that will be capable of detecting very low flux hard X-rays/gamma-rays (40-1000 keV) from astronomical objects. A specially designed pulse-shape discriminator (PSD) selects hard X-rays/gamma-rays that has deposited energy only in the detection part. Sixty-four such counters are assembled into an array where each phoswich element acts as an active shield to the neighboring elements too. The ADCs, the TDCs, the hit-pattern latches, and the precision clock are read out by a VME-based online system, stored on an 8-mm video tape, and transmitted to the ground station. The design and performance of the pulse shape discriminator and the online system are described. Author

A92-53678

A NEW HARD X-RAY/GAMMA-RAY DETECTOR TO STUDY LOW-FLUX SOURCES ON BOARD BALLOONS

T. KAMAE, T. TAKAHASHI, M. TANAKA, S. GUNJI, S. MIYAZAKI, T. TAMURA, Y. SEKIMOTO, N. YAMAOKA (Tokyo, University,

Japan), J. NISHIMURA, N. YAJIMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) et al. IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1627-1635. refs Copyright

A new kind of phoswich counters that will be capable of detecting low flux hard X-rays/gamma-rays from astronomical objects is presented. The new phoswich counter consists of a small inorganic scintillator with a fast decay time (the detection part) glued to the interior bottom surface of a rectangular well-shaped block of another inorganic scintillator with a slow decay time (the shielding part). The whole assembly is viewed by a phototube from the exterior bottom surface of the well-shaped scintillator. In this configuration, the well-shaped shielding part acts as an active collimator as well as an active shield. By using a specially designed pulse-shape discriminator (PSD), hard X-rays/gamma-rays that have deposited energy only in the detection part can be selected. A detector system consisting of 64 such phoswich counters is presented. Author

A92-53753

OPTIMIZATION OF DIRECT OBSERVATION SYSTEM FOR SOLIDIFICATION UNDER MICROGRAVITY

KAZUHIKO KURIBAYASHI, EIICHI SATO (Institute of Space and Astronautical Science, Sagami-hara, Japan), and HIROFUMI MIYASHITA (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2131-2135. refs Copyright

An optical system for in situ observations of solidification and crystal growth is presented. It consists of the amplitude modulation microscope and the common-path interferometer using the same objective lens. The optical principle of the latter, based on the idea proposed by Dyson, is beam splitting to s and p components and their synthesis through a pair of polarization beam splitters, rotated by 45 deg to each other. The light sources for the interferometer and the modulation microscope are laser and light emitting diodes, respectively. Consequently the electric power consumption of this system is small, several watts at most. These characteristics show that the present system can be one of the most optimized observation systems in space. Author

A92-53762

COMPACT TRIAXIAL ACCELEROMETER SYSTEMS (CTAS)

NAOYUKI MATSUMOTO, MASAHIRO TAKAYANAGI (Fujitsu, Ltd., Kawasaki, Japan), FUMIO TAKEI (Fujitsu Laboratories, Ltd., Atsugi, Japan), NAOTO KAWASE, YUTAKA ZAIKI, SHIN-ICHI KITAMURA (Fujitsu, Ltd., Kawasaki, Japan), and MASAFUMI TANAKA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2197-2202. Copyright

As the opportunities for microgravity experiment on drop towers, aircraft and spacecraft such as the Space Shuttle have increased, it has become profitable to develop systems able to detect acceleration precisely. The compact triaxial accelerometer system (CTAS) developed to do this has 12-bit precision and 10-micro-G resolution. It weighs 4 kg, and is small and light enough to fit in a floating rack with other instruments. Its low, 15-W, power consumption enables it to be powered by batteries, which also back up its nonvolatile semiconductor memory, used in data recording. Memory is housed in a cassette that can be replaced during operation. Raw analogue data is converted to digital and recorded in the cassette, to be processed afterward on the ground. Using the CTAS, accelerations on a parabolic flight aircraft and a roller coaster. Author

A92-53765

SCANNING ELECTRON MICROSCOPE IN SPACE EXPERIMENTS

AKIRA ASHIDA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), SHINJIRO KATAGIRI (Electron Optics Laboratory Corp., Japan), and YASUSHI NAKAIZUMI (Hitachi, Ltd., Naka Works, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2219-2224. refs
Copyright

The SEM system in use for space experiments is composed of (1) the space part of an electrooptic system, detectors and a sample chamber, and (2) the ground part of data processing systems such as magnified image processing and elementary analysis. The operation is done in a cooperative work between crew in space and users on the ground through a communication link, namely, by 'telescience'. The proposed SEM has performance of 20-nm resolution with 20,000-X magnification maximum in considerations of the various resource limitations and the efficient operation. The SEM system using telescience provides compact and reliable onboard hardware with minimum crew load. Author

A92-56381

CORRELATORS FOR INTERFEROMETRY - TODAY AND TOMORROW

CHIKADA YOSHIHIRO (Nobeyama Radio Observatory, Minamimaki, Japan) IN: Radio interferometry: Theory, techniques, and applications; Proceedings of the 131st IAU Colloquium, Socorro, NM, Oct. 8-12, 1990. San Francisco, CA, Astronomical Society of the Pacific, 1991, p. 26-32. refs
Copyright

Existing correlators for interferometry are reviewed, and prospects for future correlators are briefly considered. The advantages and disadvantages of various correlation methods are discussed and challenges for the next generation of short-wavelength interferometers are examined. C.D.

A92-56391

PHASE CONTROL IN THE DIGITAL LENS

KUNYUKI ASUMA (Souka High School, Japan), SEICHIRO IWASE, KAZUHIKO NISIBORI (Sony Corp., Atsugy Research Center, Japan), JUNICHI NAKAJIMA, EIICHIRO OTOBE, AKIRA TUCHIYA, NAOKI WATANABE, and TSUNEAKI DAISIDO (Waseda University, Tokyo, Japan) IN: Radio interferometry: Theory, techniques, and applications; Proceedings of the 131st IAU Colloquium, Socorro, NM, Oct. 8-12, 1990. San Francisco, CA, Astronomical Society of the Pacific, 1991, p. 90-93.
Copyright

Phase control in a digital lens by manipulating the radiation field is discussed. The application of such control to phase switching and the calibration of phase and amplitude is examined. C.D.

A92-56408

THE BISPECTRUM ANALYSIS TECHNIQUE IN MILLIMETER INTERFEROMETRY

KOH-ICHIRO MORITA (Nobeyama Radio Observatory, Minamimaki, Japan) IN: Radio interferometry: Theory, techniques, and applications; Proceedings of the 131st IAU Colloquium, Socorro, NM, Oct. 8-12, 1990. San Francisco, CA, Astronomical Society of the Pacific, 1991, p. 197-201. refs
Copyright

An application is proposed of the bispectrum analysis technique in millimeter interferometry, which is used in the speckle masking technique. For the millimeter interferometry, in which atmospheric phase fluctuations are very serious, not only bispectrum phase but also bispectrum amplitude is good observable. An algorithm to reconstruct images directly from bispectrum has been developed. Good maps have been made with this algorithm in the case of both simple and compact sources. Author

A92-56417

APPLICATION OF AN ESTIMATOR-FREE INFORMATION CRITERION (WIC) TO APERTURE SYNTHESIS IMAGING

M. ISHIGURO (Institute of Statistical Mathematics, Tokyo, Japan), K. I. MORITA, and M. ISHIGURO (Nobeyama Radio Observatory,

Minamimaki, Japan) IN: Radio interferometry: Theory, techniques, and applications; Proceedings of the 131st IAU Colloquium, Socorro, NM, Oct. 8-12, 1990. San Francisco, CA, Astronomical Society of the Pacific, 1991, p. 243-247. Research supported by MOESC. refs
Copyright

A statistical criterion for stopping the CLEAN procedure is proposed. The criterion is an estimator of the Kullback-Leibler information quantity, which is a measure of the goodness of statistical models. C.D.

N92-29284*# Fukui Univ. (Japan).

ROTATIONAL RAMAN LIDAR FOR LOWER TROPOSPHERIC TEMPERATURE PROFILING

TAKAO KOBAYASHI, TAKUNORI TAIRA, TAKANOBU YAMAMOTO, AKIHIRO HORI (Kansai Electric Power Corp. Ltd., Amagasaki, Japan), and TOSHINOBU KITADA (Kansai Electric Power Corp. Ltd., Amagasaki, Japan) /n NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 205-208 Jul. 1992
Avail: CASI HC A01/MF A04

Accurate sensing of the tropospheric temperature profile is basically needed in meteorology and 3D mapping of the boundary layer atmospheric temperature over urban and industrial areas. Several temperature lidar techniques were investigated, including Differential Absorption Lidar (DIAL), rotational and vibrational Raman, Rayleigh and high resolution Rayleigh schemes. For the tropospheric applications, the rotational Raman scheme looks potentially advantageous, but several stringent technical problems still remain to be solved. Reported here are the continuing efforts of the system development of the rotational Raman lidar. Author

N92-31027*# Shinshu Univ., Nagano (Japan). Faculty of Engineering.

A RANGE-RESOLVED BISTATIC LIDAR USING A HIGH-SENSITIVE CCD-CAMERA

K. YAMAGUCHI, A. NOMURA, Y. SAITO, and T. KANO /n NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 431-432 Jul. 1992 Prepared in cooperation with Meisei Electric Co. Ltd., Moriya, Japan
Avail: CASI HC A01/MF A03

Until now monostatic type lidar systems have been mainly utilized in the field of lidar measurements of the atmosphere. We propose here a range-resolved bistatic lidar system using a high-sensitive cooled charge coupled device (CCD) camera. This system has the ability to measure the three dimensional distributions of aerosol, atmospheric density, and cloud by processing the image data of the laser beam trajectory obtained by a CCD camera. Also, this lidar system has a feature that allows dual utilization of continuous wave (CW) lasers and pulse lasers. The scheme of measurement with this bistatic lidar is shown. A laser beam is emitted vertically and the image of its trajectory is taken with a remote high-sensitive CCD detector using an interference filter and a camera lens. The specifications of the bistatic lidar system used in the experiments are shown. The preliminary experimental results of our range-resolved bistatic lidar system suggest potential applications in the field of lidar measurements of the atmosphere. Author

N92-31054*# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

A HIGH SPEED SIGNAL PROCESSING SYSTEM FOR A DIODE-PUMPED YAG LIDAR

H. OKUMURA, T. SUGITA, H. MATSUMOTO, N. TAKEUCHI, and S. KUWASHIMA (OKK, Inc., Tokyo, Japan) /n NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 537-539 Jul. 1992
Avail: CASI HC A01/MF A03

Usually, in acquisition of the lidar echo signal, a transient recorder has been used. However, in the case of using a high-repetitive laser, such as a diode-pumped YAG laser, as a lidar light source, the acquisition speed of a transient recorder is not fast enough. A system using a sampling and direct accumulation

35 INSTRUMENTATION AND PHOTOGRAPHY

in a clock cycle, before transferring digital data to a computer, is necessary for a fast acquisition, and a new system which equips the necessary functions was developed and is reported. Author

N92-31088*# National Inst. for Environmental Studies, Tsukuba (Japan).

SPECTROSCOPIC METHOD FOR EARTH-SATELLITE-EARTH LASER LONG-PATH ABSORPTION MEASUREMENTS USING RETROREFLECTOR IN SPACE (RIS)

NOBUO SUGIMOTO, ATSUSHI MINATO, and YASUHIRO SASANO /in NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 659-662 Jul. 1992
Avail: CASI HC A01/MF A03

The Retroreflector in Space (RIS) is a single element cube-corner retroreflector with a diameter of 0.5 m designed for earth-satellite-earth laser long-path absorption experiments. The RIS is to be loaded on the Advanced Earth Observing System (ADEOS) satellite which is scheduled for launch in Feb. 1996. The orbit for ADEOS is a sun synchronous subrecurrent polar-orbit with an inclination of 98.6 deg. It has a period of 101 minutes and an altitude of approximately 800 km. The local time at descending node is 10:15-10:45, and the recurrent period is 41 days. The velocity relative to the ground is approximately 7 km/s. In the RIS experiment, a laser beam transmitted from a ground station is reflected by RIS and received at the ground station. The absorption of the intervening atmosphere is measured in the round-trip optical path. Author

N92-31098*# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

A PORTABLE LIDAR USING A DIODE-PUMPED YAG LASER

N. TAKEUCHI, H. OKUMURA, T. SUGITA, H. MATSUMOTO, and S. YAMAGUCHI (Nippon Steel Corp., Sagamihara, Japan) /in NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 695-698 Jul. 1992
Avail: CASI HC A01/MF A03

A Mie lidar system is technically established and is used for monitoring air pollution, stratospheric and boundary layer aerosol distribution, plume dispersion, visibility, and the study of atmospheric structure and cloud physics. However, a lidar system is not widely used because of its cumbersome handling and unwieldy portability. Although the author developed a laser diode lidar system based on RM-CW technique, it has a limit of measurement distance. Here we report the development of an all solid Mie lidar system using a diode-pumped Nd:YAG laser and a Si-APD detector. This was constructed as a prototype of a handy lidar system. Author

N92-31340# National Inst. for Fusion Science, Nagoya (Japan). **NEW HIGH VOLTAGE PARALLEL PLATE ANALYZER**

Y. HAMADA, Y. KAWASUMI, K. MASAI, H. IGUCHI, A. FUJISAWA, and Y. ABE (Iwate Univ., Morioka, Japan) Jan. 1992 16 p
Submitted for publication
(NIFS-128; ISSN-0915-633X) Avail: CASI HC A03/MF A01

A new modification of the parallel plate analyzer for 500 keV heavy ions designed to eliminate the effect of the intense UV and visible radiations was successfully conducted. The principle of the modification and the results are discussed. Author

Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Aug. 1991, p. 1738, 1739. refs
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A92-10408

EXCLUSIVE ANTI-STOKES RAMAN SCATTERING USING COHERENT MATERIAL EXCITATION

SATOSHI WADA, MASASHI KURACHI, TADAMITSU ARASAKI, AKINARI KASAI, and HIDEO TASHIRO (Institute of Physical and Chemical Research, Wako, Japan) Optics Letters (ISSN 0146-9592), vol. 16, Oct. 15, 1991, p. 1581-1583. refs
Copyright

A new process for efficient generation of anti-Stokes waves in stimulated electronic Raman scattering is proposed. The process requires no population inversion, but the exclusive coupling of the accumulated excitation and the pumping electric field which results from angular momentum conservation produces polarizations oscillating at the anti-Stokes frequency. The feasibility of this type of process is demonstrated using barium vapor. C.D.

A92-10411

INJECTION LOCKING OF A HIGHLY COHERENT AND HIGH-POWER DIODE LASER AT 1.5 MICRON

K. NAKAGAWA, M. TESHIMA, and M. OHTSU (Tokyo Institute of Technology, Yokohama, Japan) Optics Letters (ISSN 0146-9592), vol. 16, Oct. 15, 1991, p. 1590-1592. refs
Copyright

Injection locking has been employed to improve the coherence of a high-power diode laser at 1.5 micron. The injected high-power laser emitted in a single mode with a side-mode suppression ratio of larger than 30 dB and an output power of 40 mW. The FM noise of the slave laser was nearly the same as that of the submegahertz-linewidth master laser. The coherent addition of the master and the injection-locked slave laser with a residual phase error of less than 0.2 rad has been demonstrated. Author

A92-10412

PREPULSE-FREE 30-TW, 1-PS ND:GLASS LASER

K. YAMAKAWA, H. SHIRAGA, Y. KATO (Osaka University, Suita, Japan), and C. P. J. BARTY (Stanford University, CA) Optics Letters (ISSN 0146-9592), vol. 16, Oct. 15, 1991, p. 1593-1595. Research supported by MOESC and Science and Technology Agency of Japan. refs
Copyright

A 30-TW, 1.0-ps laser pulse at 1053 nm has been generated by chirped-pulse amplification in a large-aperture Nd:phosphate glass laser system. A peak-to-prepulse intensity ratio of better than $10 \exp 7$ was obtained by temporal windowing of a self-phase-modulated chirped pulse before amplification and compression. Author

A92-11040

NEW TYPE OF HIGH-RESOLUTION SPECTROSCOPY WITH A DIODE LASER

T. YABUZAKI, T. MITSUI, and U. TANAKA (Kyoto University, Japan) Physical Review Letters (ISSN 0031-9007), vol. 67, Oct. 28, 1991, p. 2453-2456. refs
Copyright

A phenomenon observed in a simple experiment with a diode laser is found to be a basis for a powerful spectroscopy. In this spectroscopy, the laser frequency is neither scanned nor modulated. High-resolution spectra in a wide radio-frequency range, such as Zeeman and hyperfine spectra in both of the ground and the excited states, are observed simultaneously by frequency analyzing the intensity fluctuation of the light transmitted through a sample cell. Demonstrating experiments are carried out with respect to the D1 and D2 lines of Cs and Rb atoms. Author

A92-11838

ANALYSIS OF THE ELASTIC WAVE EXCITATION IN SOLID PLATES BY PHASE VELOCITY SCANNING OF A LASER BEAM

YUSUKE TSUKAHARA (Toppan Printing Co., Ltd., Sugito, Japan)

36

LASERS AND MASERS

Includes parametric amplifiers.

A92-10305

GENERATION OF A DIFFRACTION-FREE LASER BEAM USING A SPECIFIC FRESNEL ZONE PLATE

TAKEHIKO HIDAKA (Electrotechnical Laboratory, Tsukuba,

Applied Physics Letters (ISSN 0003-6951), vol. 59, Nov. 4, 1991, p. 2384, 2385. refs
Copyright

A theory is presented for the propagation of elastic waves in a plate excited by scanning a laser beam at a constant velocity. A formula for the excitation by scanning a line-focused laser beam is deduced from a general formula and analyzed extensively in a two-dimensional model. It is derived that such modes of Lamb waves are selectively excited whose phase velocities match the scanning velocity. It is also shown that major characteristics of experimental observations previously made are explained with the present model. Author

A92-12645
INDUSTRIAL AND SCIENTIFIC USES OF HIGH-POWER LASERS; PROCEEDINGS OF THE MEETING, THE HAGUE, NETHERLANDS, MAR. 13-15, 1991

JEAN P. BILLON, ED. (CEA, Vaujours, France) and EDOUARD FABRE, ED. (Ecole Polytechnique, Palaiseau, France) Meeting sponsored by European Physical Society, European Federation for Applied Optics, and SPIE. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 1502), 1991, 353 p. No individual items are abstracted in this volume.

(SPIE-1502) Copyright

Consideration is given to industrial and scientific applications of high-power YAG and CO₂ lasers. Particular attention is given to study of different optical fibers, present and future trends of laser material processing in Japan, a new approach to creation of stable and unstable active resonators for high-power solid-state lasers, experiments on convection of laser-melted pools, melt dynamics and surface deformation in processing with laser radiation, variation of magnetic properties of iron-containing quartzite irradiated by CO₂ laser, the output pulse and energy capabilities of the PHEBUS laser facility, high-power lasers and the production of energy by inertial fusion, plasma interaction with powerful laser beams, numerical simulation of energy transport mechanisms in high-intensity laser-matter interaction experiments, and opacity studies with laser-produced plasma as an X-ray source. O.G.

A92-13458
SINGLE-PHOTON MICHELSON'S INTERFERENCE EXPERIMENTS USING PULSED LIGHT

SHUICHI KINOSHITA and TAKASHI KUSHIDA (Osaka University, Toyonaka, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2932-2941. refs
Copyright

A Michelson's interference experiment has been performed using a single-photon counting under the condition that at most one photon is present in the interferometer. A CW mode-locked Ar(+) laser has been employed as a light source. It has been found that the dependence of the visibility on the difference in the two arm lengths measured on a single-photon level is the same as that for the multiphoton interference experiment. This dependence and the distribution of the photon detection time measured simultaneously by a time-correlated single-photon counting method have been found to be explained well by assuming that all the photons in the mode-locked laser pulse examined have the same temporal and spectral characteristics. A quantum mechanical analysis of this kind of experiment is also presented. Author

A92-13663
ANALYSIS OF MODULATION CHARACTERISTICS OF SELF-TERMINATING METAL VAPOR LASERS

HIROSHI TANIGUCHI (Iwate University, Morioka, Japan) and SHINJI TANOSAKI Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 1984-1990. refs (Contract MOESC-61550269; MOESC-63550281)
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Analyses with a small-signal approximation on static and modulation characteristics of self-terminating metal vapor lasers

are presented based on the rate equations, whereby physically well-defined solutions are obtained. The dynamic responses with an exact analysis of relaxation oscillations in self-terminating metal vapor lasers are also found to be in agreement with those of the small-signal analysis. It is found from both the small-signal and the dynamic response analyses that the modulation characteristics in the decay rate of the cavity exhibit a wider dynamic range on the modulation frequency than that in the excitation rate. Author

A92-13666
GLOW AUXILIARY ELECTRICAL DISCHARGE FOR CW HIGH-POWER CO₂ LASERS

SETSUO SUZUKI, ETSUO NODA, and OSAMI MORIMIYA (Toshiba Corp., Toshiba Research and Development Center, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2085-2091. refs
Copyright

A new discharge technique for DC glow auxiliary electrical discharge (GAED) lasers has been developed in order to realize efficient, stable and compact CW transverse-flow high-power CO₂ lasers. The auxiliary discharge power source for GAED is common to that of the main discharge. The discharge technique and characteristics of GAED are described. The luminous region of the positive column with auxiliary discharge became wider and more uniform than that without auxiliary discharge. The limited glow discharge power (the discharge power for initiating unstable glow discharge) with auxiliary discharge was about 2.2 times that without auxiliary discharge. It was also found that the maximum value of glow discharge power was obtained when the CO₂ gas mixture ratio was 2-4 percent. Author

A92-14586
PR(3+)-DOPED FLUORIDE FIBER AMPLIFIER OPERATING AT 1.31 MICRON

YASUTAKE OHISHI, TERUTOSHI KANAMORI, TAKESHI KITAGAWA, SHIRO TAKAHASHI (NTT, Opto-Electronics Laboratories, Tokai, Japan), ELIAS SNITZER, and GEORGE H. SIGEL, JR. (Rutgers University, Piscataway, NJ) Optics Letters (ISSN 0146-9592), vol. 16, Nov. 15, 1991, p. 1747-1749. refs
Copyright

The use of a Pr(3+)-doped fluoride fiber amplifier as a practical amplifier operating at the 1.3-micron band, based on a demonstration of signal amplification and a spectroscopic investigation is proposed. The feasibility of the fluoride fiber amplifier is confirmed. Author

A92-14651
LASER DIODE PUMPED PR(3+)-DOPED AND PR(3+)-YB(3+)-CODOPED FLUORIDE FIBRE AMPLIFIERS OPERATING AT 1.3 MICRON

Y. OHISHI, T. KANAMORI, M. YAMADA, M. SHIMIZU, K. YOSHINO, H. HANAFUSA, M. HORIGUCHI, S. TAKAHASHI (NTT, Opto-Electronics Laboratories, Tokai, Japan), J. TEMMYO, and M. WADA (NTT, Opto-Electronics Laboratories, Atsugi, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Oct. 24, 1991, p. 1995, 1996. refs
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A92-14660
MONOLITHIC RESONANT OPTICAL REFLECTOR LASER DIODES

T. HIRATA, M. SUEHIRO, M. MAEDA, M. HIHARA, and H. HOSOMATSU (Optical Measurement Technology Development Co., Ltd., Central Research Laboratory, Musashino, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Oct. 24, 1991, p. 2050, 2051. refs
Copyright

The first monolithic resonant optical reflector laser diode that has a waveguide directional coupler and two DBR reflectors integrated by compositional disordering of quantum-well heterostructures is described. A linewidth of 440 kHz was obtained, and this value is expected to be greatly decreased by reducing the propagation loss in the integrated waveguide. Author

A92-16163**CUMULATIVE LASER IRRADIATION EFFECTS ON IONS IN THE PLUME OF YBa2Cu3O(7-DELTA) AND PARTICULATES AT THE FILM SURFACE**

H. IZUMI, K. OHATA, T. SAWADA, T. MORISHITA, and S. TANAKA (International Superconductivity Technology Center, Tokyo, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 2, 1991, p. 2950-2952. Research supported by New Energy and Industrial Technology Development Organization. refs

Copyright

Direct observations of ions in the laser plume of YBa2Cu3O(7-delta) impinging onto a substrate surface revealed the increase of heavy species in the plume after multiple laser pulses on the YBa2Cu3O(7-delta) target. The beginning of heavy species emission from the target was observed at around 100 laser beam pulses (1 J/sq cm) in the experiments. Particulate formation at the film surface was observed in the film deposited under this condition. Author

A92-16366**SINGLE-LONGITUDINAL-MODE OPERATION AND SECOND-HARMONIC GENERATION OF Nd:YVO4 MICROCHIP LASERS**

T. SASAKI, T. KOJIMA, A. YOKOTANI, O. OGURI, and S. NAKAI (Osaka University, Japan) Optics Letters (ISSN 0146-9592), vol. 16, Nov. 1, 1991, p. 1665-1667. refs

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A single-mode output of 221 and 16 mW for the fundamental and second-harmonic light was obtained with the combination of an Nd:YVO4 microchip laser and an intracavity KTP crystal. It was found that the beam size and laser power in a plano-plano cavity were dependent on the absorption coefficient of the laser medium and that the material that had a higher absorption coefficient produced higher output power and smaller beam size in the laser cavity. This means that Nd:YVO4 is suitable not only for single-mode oscillation but also for efficient intracavity second-harmonic generation. Author

A92-17505**HIGH TEMPERATURE (OVER 150 C) AND LOW THRESHOLD CURRENT OPERATION OF ALGAINP/GA(X)IN(1-X)P STRAINED MULTIPLE QUANTUM WELL VISIBLE LASER DIODES**

T. KATSUYAMA, I. YOSHIDA, J. SHINKAI, J. HASHIMOTO, and H. HAYASHI (Sumitomo Electric Industries, Ltd., Optoelectronics Research and Development Laboratories, Yokohama, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 23, 1991, p. 3351-3353. refs

Copyright

High temperature and very low threshold current operation of a separate confinement heterostructure (SCH) AlGaInP/Ga(x)In(1-x)P (x = 0.43) strained multiple quantum well (SMQW) lasers has been achieved. Continuous wave (CW) operation was observed up to at least 150 C with an output power of more than 7 mW, which is the highest CW operating temperature ever reported for devices operating in the visible wavelength region. The characteristic temperature between 20 and 80 C was 130 K. The threshold current and threshold current density at 25 C were 13.9 mA for a 5 x 160-micron device and 430 A/sq cm for an 80 x 770-micron device. Author

A92-18410**DYNAMIC PROPERTIES OF TRANSVERSE-MAGNETIC WAVE INJECTED SEMICONDUCTOR LASERS**

YOSHIHIRO MORI (Matsushita Electric Industrial Co., Ltd., Opto-Electronics Research Laboratory, Moriguchi, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 27, Nov. 1991, p. 2415-2421. refs

Copyright

Dynamic responses of optical polarization bistability and self-sustained pulsation in transverse-magnetic (TM) wave injected semiconductor lasers are analyzed. Due to the TM wave injection, laser amplification of TM wave and laser oscillation in the

transverse-electric (TE) mode simultaneously occurs in the laser. The calculated dynamic responses of optical polarization bistability are compared with measured responses. The upper limit of the switching time and the repetition frequency are clarified from calculations. The self-sustained pulsation triggered by a change of TM input power is found in the course of the calculation. The conditions needed for the pulsation are discussed. I.E.

A92-18414**EFFICIENCY CHARACTERIZATION OF VACUUM ULTRAVIOLET MOLECULAR FLUORINE (F2) LASER (157 NM) EXCITED BY AN INTENSE ELECTRIC DISCHARGE**

MASAYUKI KAKEHATA, FUMIHIKO KANNARI, MINORU OBARA (Keio University, Yokohama, Japan), and TATSUYA UEMATSU (Toyoda Automatic Loom Works, Ltd., Kariya, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 27, Nov. 1991, p. 2456-2464. Research supported by TEPCO Research Foundation and Keio University. refs

Copyright

Detailed experimental results of a discharge-excited high-pressure F2 laser are compared with a model prediction. Special emphasis is placed on the output performance of the discharge-pumped F2 laser at extremely high excitation rates (10 to 35 MW/cu cm) by using high-pressure laser mixtures up to 8 atm. The kinetics model predicts fractional contributions of excited F2 formation channels, relaxation channels, and absorption channels together with the formation and extraction efficiencies at the experimental conditions. Although the only experimental quantity compared with the model prediction is laser output energy, it is enough to obtain a better understanding of major F2 laser kinetics and key issues for improving the efficiency. I.E.

A92-18416**HIGH POWER AND HIGH FOCUSING CW CO2 LASER USING AN UNSTABLE RESONATOR WITH A PHASE-UNIFYING OUTPUT COUPLER**

YUSHI TAKENAKA, MASAKI KUZUMOTO, KOJI YASUI (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan), SHIGENORI YAGI (Mitsubishi Electric Corp., Nagoya Works, Japan), and MOTOSHI TAGASHIRA (Tokyo Electric Power Co., Engineering Development Center, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 27, Nov. 1991, p. 2482-2487. Research supported by Tokyo Electric Power Co. and Mitsubishi Electric Corp. refs

Copyright

A high-power and high-focusing continuous-wave (CW) CO2 laser with a novel unstable resonator was developed. This resonator contains a step-wise variable reflecting output coupler named the phase-unifying output coupler and a total reflector. The laser was excited by a capacitive-barriered ac discharge called a silent discharge. A linearly polarized laser beam with a diffraction-limited divergence angle of 0.55 mrad was obtained. Very stable CW laser operation at an output power of 5 kW was achieved with a threshold discharge power of 10 kW and a slope efficiency of 18 percent. I.E.

A92-18423**GAIN CHARACTERISTICS OF PR3(+)-YB3(+) CODOPED FLUORIDE FIBER FOR 1.3 MICRON AMPLIFICATION**

YASUTAKE OHISHI, TERUTOSHI KANAMORI, TOSHIHIRO NISHI, SHIRO TAKAHASHI (NTT, Opto-Electronics Laboratories, Ibaraki, Japan), and ELIAS SNITZER (Rutgers University, Piscataway, NJ) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Nov. 1991, p. 990-992. refs

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The ability of the Pr(3+)-Yb(3+) codoped system to move the pumping wavelength to wavelengths shorter than 1.017 micron is investigated. It was demonstrated that, by codoping of Yb(3+) with Pr(3+)-doped fluoride fiber, amplifiers can be moved to the spectral range where effective pumping can be done with InGaAs laser diodes that have strained-layer quantum-well structures that were developed as a pumping source for Er(3+)-doped fiber

amplifiers. The pumping wavelength range was extended down to 0.93 micron. I.E.

A92-18424

1.55 MICRON POLARIZATION-INSENSITIVE HIGH-GAIN TENSILE-STRAINED-BARRIER MQW OPTICAL AMPLIFIER

KATSUAKI MAGARI, MINORU OKAMOTO, and YOSHIO NOGUCHI (NTT, Opto-Electronics Laboratories, Kanagawa, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Nov. 1991, p. 998-1000. refs
Copyright

A polarization insensitive semiconductor optical amplifier was realized at a wavelength of 1.55 microns. The active layer consisted of a tensile-strained-barrier multiple quantum well (MQW) structure. At a driving current of 150 mA, no dependence of the saturation characteristics on modes was obtained. The saturation output power at which the gain decreases 3 dB is 13.3 dBm. A slightly higher saturation output power of 14 dBm was measured at a driving current of 200 mA. No large difference was observed between transverse-electric (TE) and transverse-magnetic (TM) modes. A high gain of 27.5 dB at a polarization sensitivity of 0.5 dB and a high saturation output of 14 dBm were realized simultaneously by using a longer device with reduced residual facet reflectivities. I.E.

A92-18916

HIGHLY RELIABLE 100 MW OPERATION OF BROAD AREA INGAALP VISIBLE LIGHT LASER DIODES

K. ITAYA, N. SHIMADA, and G. HATAKOSHI (Toshiba Corp., Kawasaki, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Nov. 21, 1991, p. 2257-2259. refs
Copyright

The aging characteristics of broad area InGaAlP visible light laser diodes have been investigated. Asymmetric coatings and a highly p-doped cladding layer were employed. Highly reliable operation, as high as 100 mW for more than 2000 h has been realized at 15 C. Author

A92-18931

TUNABLE LASER DIODE HAVING A COMPLEMENTARY TWIN-ACTIVE-GUIDE (CTAG) STRUCTURE

EIJI YAMAMOTO, KAZUYA SUDA, MADOKA HAMADA, SEIJI NOGIVA, and TOKUKOH OKI (Optical Measurement Technology Development Co., Ltd., Musashino, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1884-L1886. refs
Copyright

A new type of tunable laser, the complementary twin-active-guide (CTAG) laser is proposed, and the preliminary experimental results of its tuning characteristics are presented. A wide continuous tuning range over 4 nm is obtained for the CTAG laser. In the CTAG laser, not only power reduction but also spectral line-width broadening during tuning are greatly improved in comparison to conventional tunable twin-guide lasers and three-section DBR lasers. Author

A92-18932

PARTICLE ACCELERATION BY LONGITUDINAL FIELD IN TWO SUPERPOSED LASER BEAMS

KAZUO SAKAI (Yamanashi University, Kofu, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1887, L1888. refs
Copyright

A method for creating a longitudinal field by using two laser beams is developed which is an alternative to the scheme proposed by Scully (1990). It is shown theoretically that it is possible to produce a longitudinal electric field by superposing two laser beams in the appropriate configuration, in which electrons can be accelerated to very high energies. I.S.

A92-18933

ACTIVELY AND PASSIVELY MODE-LOCKED Nd:YAP(YALO3) LASER WITH NEGATIVE FEEDBACK USING CDSE AND GAAS

VACLAV KUBECEK, SHIGEICHI KUMAZAKI, YOSHIHIRO TAKAGI, KEITARO YOSHIHARA (Institute for Molecular Science, Okazaki, Japan), and GIANCARLO C. REALI (Pavia, Universita, Italy) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1889-L1891. refs
Copyright

The feedback-controlled mode-locking operation of a flash-lamp-pumped Nd:YAP(YALO3) laser using a CdSe passive element is reported for the first time. Pulse trains with a duration of 1000 ns, single pulse width of 5 ps, and pulse energy of 10 microJ are generated. The performances of CdSe and GaAs negative feedback elements are compared. Author

A92-19352

HIGH-EFFICIENCY SECOND-STOKES-ORDER RAMAN CONVERSION OF KRF LASER RADIATION IN HYDROGEN

YUNSHENG HUO, KOUKI SHIMIZU, and TAKASHI YAGI (Institute of Research and Innovation, Kashiwa, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, Jan. 1, 1992, p. 45-48. refs
Copyright

Generation of the second Stokes order with a photon efficiency of 68 percent has been obtained from a single-pass hydrogen Raman oscillator. The third-order Stokes generated by four-wave mixing is effectively suppressed by phase mismatching. The 1.6 times diffraction-limited pump-beam quality used in the present experiment was found to be essential to the high-efficiency second-Stokes-order generation. Author

A92-20028

EFFECT OF CAVITY SIZE ON LASTING CHARACTERISTICS OF A DISTRIBUTED BRAGG REFLECTOR-SURFACE EMITTING LASER WITH BURIED HETEROSTRUCTURE

K. MORI, T. ASAKA, H. IWANO (Seiko Epson Corp., Compound Semiconductors Laboratory, Nagano, Japan), M. OGURA, S. FUJII, T. OKADA, and S. MUKAI (Electrotechnical Laboratory, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 6, 1992, p. 21, 22. refs
Copyright

Transverse-mode characteristics of the distributed Bragg reflector-surface emitting laser diode with buried heterostructure were investigated as a function of the cavity size. Stable, fundamental transverse-mode operation was achieved for cavity openings of 4 microns in diameter and smaller. The effect of cavity size on threshold current and polarization characteristics is also discussed. Author

A92-20778

OUTPUT CHARACTERISTICS OF AN OPTICALLY PUMPED TA VAPOR LASER

H. YOSHIDA, H. NINOMIYA, and N. TAKASHIMA (Shikoku Research Institute, Inc., Matsuyama, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Dec. 15, 1991, p. 7253-7256. refs
Copyright

Output characteristics of an optically pumped tantalum-vapor laser and the distribution of tantalum vapor generated by irradiation of a laser are investigated experimentally. Ta vapor is generated by irradiation of a pulsed YAG laser, and then the Ta atoms are optically pumped by a KrF-excimer laser. It is observed that the maximum output energy is 160 nJ, the maximum optical-conversion efficiency is 0.01 percent, and the ground-state Ta atoms are distributed not only in the luminous space of the vapor but also around it. Author

A92-21375

COMPACT, SEMI-SEALED-OFF, HIGH-REPETITION-RATE TRANSVERSELY EXCITED ATMOSPHERIC-PRESSURE CO2 LASER WITH A SURFACE-WIRE CORONA PREIONIZATION

MASAKATSU SUGII, TAKAO KOMI, and HIROSHI HARA (Japan Defense Agency, Technical Research and Development Institute, Tokyo, Japan) Review of Scientific Instruments (ISSN 0034-6748), vol. 62, Dec. 1991, p. 3108, 3109. refs
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A92-22014

NEW LASER ACTION OF OPTICALLY PUMPED ATOMIC VANADIUM VAPOR

H. YOSHIDA, N. TAKASHIMA, and H. NINOMIYA (Shikoku Research Institute, Inc., Matsuyama, Japan) *Journal of Applied Physics* (ISSN 0021-8979), vol. 71, Jan. 15, 1992, p. 1044, 1045. refs

Copyright

Laser action has been observed on the vanadium 560.4-, 575.3-, 581.7-, and 637.9-nm lines. Vanadium vapor is produced from vanadium metal plate by YAG laser (2.0 J/pulse) irradiation, and optically pumped by an XeCl excimer laser of 25-mJ energy. The vanadium laser pulse has a duration of 50 ns and peak output power of about 7 W. Author

A92-22028

CONTINUOUS-WAVE SUM-FREQUENCY GENERATION NEAR 194 NM IN BETA-BaB2O4 CRYSTALS WITH AN ENHANCEMENT CAVITY

MASAYOSHI WATANABE, KAZUHIRO HAYASAKA, HIDETSUKA IMAJO, and SHINJI URABE (Kansai Advanced Research Center, Kobe, Japan) *Optics Letters* (ISSN 0146-9592), vol. 17, Jan. 1, 1992, p. 46-48. refs

Copyright

Continuous-wave coherent radiation tunable near 194 nm has been generated using sum-frequency generation in beta-BaB2O4 placed inside an external enhancement cavity. An output power of 16 micro-W has been obtained with a walk-off-compensated configuration of beta-BaB2O4 crystals. Author

A92-22032

PULSE EVOLUTION DYNAMICS OF A FEMTOSECOND PASSIVELY MODE-LOCKED Ti:SAPPHIRE LASER

NOBUHIKO SARUKURA and YUZO ISHIDA (NTT, Basic Research Laboratories, Musashino, Japan) *Optics Letters* (ISSN 0146-9592), vol. 17, Jan. 1, 1992, p. 61-63. refs

Copyright

The pulse-formation process in a passively mode-locked Ti:sapphire laser with a saturable absorber has been investigated. It is concluded that the function of the saturable absorber is to induce the initial modulation and to shorten the pulse-formation time. The advantages of the saturable absorber include the certainty of self-starting and the robustness against external perturbation. O.G.

A92-22043

MULTIBEAM LASER MANIPULATION AND FIXATION OF MICROPARTICLES

HIROAKI MISAWA, KEIJI SASAKI, MASANORI KOSHIOKA, NOBORU KITAMURA, and HIROSHI MASUHARA (Research Development Corporation of Japan, Kyoto) *Applied Physics Letters* (ISSN 0003-6951), vol. 60, Jan. 20, 1992, p. 310-312. refs

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A multibeam laser trapping-reaction system was developed to demonstrate independent manipulation of plural microparticles as well as to induce photochemical reaction in a laser-trapped particle(s). Photopolymerization of vinyl monomers dissolved in a sample solution was employed to fix polystyrene latex particles regularly aligned by laser trapping. Integrated latex structures created by the successive manipulation/polymerization procedures were also shown to be freely manipulated by laser beams. Author

A92-22084

LASERS WITHOUT INVERSION IN MICROCAVITIES

YOSHIHISA YAMAMOTO (NTT, Basic Research Laboratories, Musashino, Japan) and GUNNAR BJORK (Royal Institute of Technology, Stockholm, Sweden) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2039-L2041. refs

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The lasing characteristics of microcavity lasers with high coupling efficiency of spontaneous emission into the lasing mode

are studied. Output power, population inversion, spectral linewidth and intensity noise are calculated as functions of pumping rate. When the spontaneous emission coupling efficiency into the lasing mode is close to one, a lasing threshold characterized by a sharp increase in an output power, a clamping of population inversion, a decrease in spectral linewidth and a peak in intensity noise, are observed at a pump rate in which a population inversion is not created yet. A physical interpretation for lasing without inversion in a microcavity is given on the basis of a photon recycling picture consisting of dissipation-free stimulated emission and re-absorption. Author

A92-23871

MODE STRUCTURE AND AMPLIFICATION OF RADIATION IN THE PHOTON STORAGE RING

KUNIOKI MIMA (Osaka University, Japan), HIRONARI YAMADA (Sumitomo Heavy Industries, Ltd., Tokyo, Japan), and KOICHI SHIMODA *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 27, Dec. 1991, p. 2572-2579. refs

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Eigenmodes and their growth rate in the photon storage ring (PhSR) are studied theoretically. In PhSR the synchrotron radiation emitted tangentially from the electron storage ring is reflected by a cylindrical mirror which surrounds the electron orbit. The radiation, thus confined in the cylindrical cavity, is represented by eigenmodes of very high mode numbers. It is found that the coherent radiation may build up, when the phase velocity of the eigenmode along the electron orbit is close to the electron velocity. The growth rate of this laser is evaluated for the compact electron storage ring AURORA. I.E.

A92-23905

CONTROL OF UNIDIRECTIONAL OSCILLATION IN SEMICONDUCTOR ORBITER LASERS

SATOSHI OKU, MASANOBU OKAYASU, and MASAHIRO IKEDA (NTT, Opto-Electronics Laboratories, Kanagawa, Japan) *IEEE Photonics Technology Letters* (ISSN 1041-1135), vol. 3, Dec. 1991, p. 1066-1068. refs

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Unidirectional oscillation in a ring-resonator-type semiconductor laser was demonstrated in a square-shaped orbiter laser using an optical feedback mechanism. The bistable switching phenomenon between the unidirectional and bidirectional oscillation was observed synchronized with the switching of the longitudinal lasing mode. A longitudinal-mode bistability results from the compound cavity system formed by the orbiter laser and the output waveguide. The feedback light from the output waveguide end interferes with the orbiter lasing light. Switching between the unidirectional and bidirectional oscillation was controlled by injecting a current into the output waveguide, which varies the phase condition of the feedback light. I.E.

A92-25813

A SUBMILLIAMPERE-THRESHOLD MULTIQUANTUM-WELL ALGAS LASER WITHOUT FACET COATING USING SINGLE-STEP MOCVD

HIRONOBU NARUI, SHOJI HIRATA, and YOSHIFUMI MORI (Sony Corp., Research Center, Yokohama, Japan) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, Jan. 1992, p. 4-8. refs

Copyright

An extremely low threshold current of 0.88 mA under continuous wave (CW) operation was obtained for a three-quantum-well AlGaAs-GaAs laser without facet coating at room temperature. This laser was fabricated using only single-step metalorganic chemical vapor deposition (MOCVD) on a nonplanar GaAs substrate. The energy conversion efficiency from input electric power to light output power was 42 percent at 1 mW/facet, which is the highest value for all types of lasers. The laser beam shape was nearly round with an aspect ratio of 0.86. I.E.

A92-25821
ANALYSIS OF CURRENT INJECTION EFFICIENCY OF
SEPARATE-CONFINEMENT-HETEROSTRUCTURE
QUANTUM-FILM LASERS

HIDEKI HIRAYAMA, YASUNARI MIYAKE, and MASAHIRO ASADA (Tokyo Institute of Technology, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Jan. 1992, p. 68-74. Research supported by MOESC and Research Center for Ultra-High-Speed Electronics. refs
 Copyright

Current injection efficiency, i.e., the proportion of current into the active region to total current, is analyzed for separate confinement heterostructure (SCH) quantum film lasers. It is shown that the current injection efficiency changes stepwise with the active layer thickness, and is larger for lower injected carrier density and deeper quantum well. Comparison is made between step-, parabolic-GRIN-, and linear-GRIN-SCH structures. The efficiency of linear-GRIN-SCH is the highest for the same well depth. Threshold current density is discussed for these SCH structures, taking into account the current injection efficiency and the optical loss due to the carrier leakage to the optical confinement layers.
 I.E.

A92-25822
FREQUENCY STABILIZATION OF LASER DIODES USING
1.51-1.55 MICRON ABSORPTION LINES OF (C-12)2H2 AND
(C-13)2H2

YOSHIHISA SAKAI (NTT, Opto-Electronics Laboratories, Atsugi, Japan), SHOICHI SUDO, and TETSUHIKO Ikegami (NTT, Opto-Electronics Laboratories, Tokai, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Jan. 1992, p. 75-81. refs
 Copyright

Frequency stabilization of a 1.55 micron DFB laser diode is demonstrated using vibrational-rotational absorption of (C-12)2H2 and (C-13)2H2 molecules (named VRAM). Frequency stability within 2 MHz peak to peak fluctuation can be achieved in the wavelength region of 1.51-1.55 microns. Frequency-stabilized DFB laser compact modules have been constructed. Frequency stabilities are evaluated by measuring the beat spectrum of the two lasers. In addition, the temperature and pressure dependences of the acetylene absorption lines are characterized.
 I.E.

A92-25831
ENHANCED SECOND-HARMONIC GENERATION WITH
CERENKOV RADIATION SCHEME IN ORGANIC FILM
SLAB-GUIDE AT IR LINES

YUJI AZUMAI (National Defense Academy, Yokosuka, Japan), IWAO SEO (Mitsubishi Petrochemical Co., Ltd., Tsukuba, Japan), and HEIHACHI SATO (National Defense Academy, Yokosuka, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Jan. 1992, p. 231-238. refs
 Copyright

Second-harmonic generation is enhanced with both symmetric and asymmetric slab-guides composed of vinylidene cyanide/vinyl acetate copolymer film and a fused silica in the Cerenkov radiation scheme at Nd:YAG 1.06 micron and Er:YAG 2.94 micron laser lines. At 1.06 micron wavelength an enhancement factor of about five in comparison with a bulk scheme has been obtained with the symmetrical Cerenkovian configuration having the film thickness d of about 5 microns. Extending the theory to the experimental model presented, the results are well explained theoretically, and an enhancement of the SHG power by a factor of 50 can be expected if d is about 0.5 microns.
 I.E.

A92-25863
FREQUENCY STABILIZED LASER DIODE LOCKED TO
ACETYLENE GAS ABSORPTION LINES USING
FIBER-PIGTAIL-TYPE ACOUSTIC OPTICAL MODULATOR

Y. SAKAI, I. YOKOHAMA, F. KANO, and S. SUDO (NTT, Opto-Electronics Laboratories, Kanagawa, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 4, Jan. 1992, p. 96-98.

refs
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A92-26186
FOUR-DIMENSIONAL SIMULATION OF ULTRASHORT
OPTICAL SHOCK RADIATION GENERATED BY
GUIDED-WAVE FREQUENCY DOUBLING OF A PULSED
LASER DIODE

K. HAYATA and M. KOSHIBA (Hokkaido University, Sapporo, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 17, 1992, p. 796-798. Research supported by MOESC. refs
 Copyright

Using a guided-wave nonlinear-pulse simulator, we implement a spatiotemporal-domain calculation of the short-wavelength Cerenkov-shock radiation generated by frequency doubling of an ultrashort light pulse from a laser diode. Computed results for picosecond and subpicosecond blue pulse generations through the frequency doubling in a proton-exchanged MgO:LiNbO3 channel waveguide are shown. Effects due to polarization, temporal walk-off, and pump depletion are predicted.
 Author

A92-26209
REMOTE DETECTION OF METHANE WITH A 1.66-MICRON
DIODE LASER

KIYOJI UEHARA (Keio University, Yokohama, Japan) and HIDEO TAI (Tokyo Gas Co., Ltd., Information Technology Institute, Japan) Applied Optics (ISSN 0003-6935), vol. 31, Feb. 20, 1992, p. 809-814. refs
 Copyright

High-sensitivity real-time remote detection of methane in air with a 1.66-micron distributed-feedback diode laser operating at room temperature is demonstrated by laboratory simulations. The laser current was modulated at a high frequency of about 5 MHz, and the laser-center frequency was locked onto a methane-absorption line. The laser light directed toward the probed region was received after one-way transmission or further reflection from a topographic target. The methane absorption was detected by the second-harmonic component in the optical-power variation. The minimum-detectable concentration-pathlength product in the transmission scheme was 0.3 part in $10 \exp 6$ m for a signal averaging time of 1.3 s. In the reflection scheme, the amount of methane could be measured from the ratio of the fundamental and second-harmonic signal intensities independently of the receiver power.
 Author

A92-26511
LASER PROPERTIES OF NONLINEAR OPTICAL BENZAL
BARBITURIC ACID CRYSTALS

KOICHI KONDO, MASATO FUKUTOME, NORIAKI OHNISHI, HIDEYUKI ASO, YASUO KITAOKA, and TAKATOMO SASAKI (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3419, 3420. refs
 Copyright

A nonlinear optical crystal, p-methylbenzal-1,3-dimethylbarbituric acid is grown in benzene by means of a temperature-depression method into a large single crystal ($10 \times 16 \times 17$ cu mm). The cut-off wavelength is 460 nm, and the effective nonlinear optical coefficient of type I for second-harmonic generation is 8.0 pm/v.
 Author

A92-26514
A STUDY OF THE VACUUM AND EXTREME ULTRAVIOLET
EMISSIONS FROM IONIC RARE-GAS-LITHIUM AND -SODIUM
MOLECULES BY AB INITIO CALCULATION

DA XING, KEN-ICHI UEDA, and HIROSHI TAKUMA (University of Electro-Communications, Chofu, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3533-3539. Research supported by MOESC and Matsuo Foundation. refs
 Copyright

Ab initio potential calculations are reported for the ground states $1\ 1\Sigma(+)$ and the lowest excited states $2\ 1\Sigma(+)$ of the

36 LASERS AND MASERS

rare-gas-lithium and -sodium molecules arising from the $Rg(1S) + A(+)(1S)$ and the $Rg(+)(2P) + A(2S)$ separated limits, respectively. The Franck-Condon factors of the $2\ 1\Sigma(+) \rightarrow 1\ 1\Sigma(+)$ transitions are also calculated. The results predict that the emissions from the $v' = 0$ of the $2\ 1\Sigma(+)$ states to the higher vibration levels near the dissociation limits of the $1\ 1\Sigma(+)$ states have the largest transition probability. These transition wavelengths are in the vacuum to extreme ultraviolet region. V.L.

A92-27894

SHORTEST WAVELENGTH (607 NM) OPERATIONS OF GAINP/ALINP DISTRIBUTED BRAGG REFLECTOR LASERS

D.-H. JANG, Y. KANEKO, and K. KISHINO (Sophia University, Tokyo, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, Feb. 13, 1992, p. 428-430. Research supported by General Sekiyu Research and Development Encouragement and Assistance Foundation and Korea Science and Engineering Foundation. refs

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Visible light GainP/AlInP distributed Bragg reflector (DBR) lasers with second order gratings (184.7 nm period) were fabricated by gas source molecular beam epitaxy (GSMBE) and the conventional interference method for the first time. Single mode operations of GainP/AlInP DBR lasers were maintained up to over 1.8 times the threshold currents with a wavelength of 607 nm at 140 K and a wavelength shift of 0.033 nm/K. No mode hopping was observed in a temperature range from 120 to 165 K. Author

A92-28853

COHERENT PI-PULSE PROPAGATION WITH PULSE BREAKUP IN AN ERBIUM-DOPED FIBER WAVEGUIDE AMPLIFIER

MASATAKA NAKAZAWA, KAZUNORI SUZUKI, YASUO KIMURA, and HIROKAZU KUBOTA (NTT, Optical Transmission Line Laboratory, Tokai, Japan) Physical Review A (ISSN 1050-2947), vol. 45, March 1, 1992, p. R2682-R2685. refs

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Coherent pi-pulse propagation with pulse breakup has been observed in an erbium-doped fiber waveguide amplifier. The waveguide was pumped by a 1.48-micron In-Ga-As-P laser diode. The waveguide had an erbium ion concentration of 8900 ppm, and was cooled to 4.2 K. The pulse source was a 1.53-micron mode-locked Er-doped glass laser with a pulse width of 400 ps. A pulse advance of approximately 130 ps was observed between a low-intensity transmitted pulse with a low pump power and an amplified pi pulse in a 1.5-m-long fiber. Author

A92-29006

SIMULTANEOUS OSCILLATION OF WAVELENGTH-TUNABLE, SINGLEMODE LASERS USING AN ER-DOPED FIBRE AMPLIFIER

H. OKAMURA and K. IWATSUKI (NTT, Transmission Systems Laboratories, Yokosuka, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, Feb. 27, 1992, p. 461-463. refs

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A compound fiber-ring cavity with just one Er-doped fiber amplifier yields wavelength-multiplexed laser lights, each of which is wavelength-tunable and single-moded with a spectral linewidth less than 1 MHz. The allowable cavity-loss fluctuation for maintaining simultaneous lasing is about 1 dB. Author

A92-29019* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PHOTON NUMBER SQUEEZED STATES IN SEMICONDUCTOR LASERS

YOSHIHISA YAMAMOTO, SUSUMU MACHIDA (NTT, Basic Research Laboratories, Musashino, Japan), and WAYNE H. RICHARDSON (JPL, Pasadena, CA) Science (ISSN 0036-8075), vol. 255, March 6, 1992, p. 1219-1224. refs

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Electromagnetic fields, with the noise on one quadrature component reduced to below the quantum mechanical zero-point fluctuation level and the noise on the other quadrature component

enhanced to above it, are currently of great interest in quantum optics because of their potential applications to various precision measurements. Such squeezed states of light are usually produced by imposing nonlinear unitary evolution on coherent (or vacuum) states. On the other hand, squeezed states with reduced photon number noise and enhanced phase noise are generated directly by a constant current-driven semiconductor laser. This is the simplest scheme for the generation of nonclassical light, and so far it has yielded the largest quantum noise reduction. The mutual coupling between a lasing junction and an external electrical circuit provides opportunities for exploring the macroscopic and microscopic quantum effects in open systems. Author

A92-30438

DIRECT GENERATION OF CIRCULARLY POLARIZED PULSE FROM A TRANSVERSELY EXCITED ATMOSPHERIC CO₂ LASER BY INJECTION LOCKING

MITSUTOSHI SUZUKI, KATSUMI MIDORIKAWA, and HIDEO TASHIRO (Institute of Physical and Chemical Research, Wako, Japan) Applied Optics (ISSN 0003-6935), vol. 31, March 20, 1992, p. 1210-1212. refs

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The external seed of a weak, circularly-polarized (CP) beam is presently shown to be effective in controlling both the longitudinal mode and the polarization condition in a high-power slave TEA CO₂ laser oscillator. Attention is given to changes in the temporal pulse shapes and corresponding FFT spectra. The CP pulse method can simplify the CO₂ laser system for pumping of para-H₂ Raman lasers. O.C.

A92-30546

BASIC STUDY ON DISCHARGE TYPE EXCIMER LASERS

H. NAKAMURA, G. IMADA, and T. KURODA (Nakaoka Technology and Science University, Niigata, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 172-175. In Japanese. refs

A pulsed discharge-type excimer laser was tested. The density distribution in the flow in the laser cavity is computed. Pressure variations after the discharge test section are investigated. Y.P.Q.

A92-30547

ON ELECTRONIC VIBRATION IN SUPERSONIC FLOW AND MIXING CO₂ LASERS

KAZUO MAENO (Chiba University, Japan), K. KIMURA, and HIRO HANAOKA (Muroran Institute of Technology, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 176-179. In Japanese. refs

Experimental and theoretical studies of an electric-discharge mixing CO₂ supersonic flow laser are presented. The fractional power transfer of the vibrational excitation is discussed, and the gain dependence on the reservoir pressure ratio is presented. Y.P.Q.

A92-31742

GAIN SATURATION AND PROPAGATION CHARACTERISTICS OF INDEX-GUIDED TAPERED-WAVEGUIDE TRAVELING-WAVE SEMICONDUCTOR LASER AMPLIFIERS (TTW-SLA'S)

GIAMPAOLO BENDELLI, KAZUHIRO KOMORI, and SHIGEHISA ARAI (Tokyo Institute of Technology, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Feb. 1992, p. 447-458. Research supported by MOESC. refs

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A model is developed to investigate the propagation characteristics and gain saturation performances of tapered-waveguide traveling-wave semiconductor laser amplifiers (TTW-SLAs). The influences of several physical mechanisms are analyzed. Two taper geometries are studied in detail: the exponential TTW-SLA and the linear TTW-SLA. The first is shown to be more efficient for narrow tapers (output width less than 14

micron), whereas the linear TTW-SLA becomes superior for wide-taper geometries because of its better adiabatic propagation characteristics. Both tapered structures can provide a consistent improvement in the saturation output power compared to the conventional TTW-SLA, reaching absolute values on the order of about 18 dBm and about 23 dBm for the exponential and linear TTW-SLAs, respectively. The efficiency of conversion between the electrical and optical power is also improved by the tapered structure. The propagation characteristics for an exponential TTW-SLA have been measured and found in reasonable agreement with the theory. I.E.

A92-32285

GAINASP/INP SURFACE EMITTING LASERS GROWN BY CHEMICAL BEAM EPITAXY

T. UCHIDA, N. YOKOUCHI, T. MIYAMOTO, Y. INABA, F. KOYAMA, and K. IGA (Tokyo Institute of Technology, Yokohama, Japan) *Electronics Letters* (ISSN 0013-5194), vol. 28, March 12, 1992, p. 550, 551. refs

(Contract MOESC-61065002)

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A GaInAsP/InP surface emitting laser has been demonstrated grown by chemical beam epitaxy (CBE) for the first time. The device has a 30-micron round-low mesa with a 1.0 micron active layer. The threshold current as low as 2.7 mA (455 A/sq cm) was obtained under 77 K CW operation (= 1.43 micron). This is the lowest value of long wavelength SE lasers ever reported. These results show the possibility of realizing high performance SE lasers grown by CBE. Author

A92-32437

THEORETICAL ESTIMATION OF LEAKAGE CURRENT IN II-VI HETEROSTRUCTURE LASERS

IKUO SUEMUNE (Hiroshima University, Higashihiroshima, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 31, Feb. 1, 1992, p. L95-L98. refs

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II-VI heterostructures studied in terms of lasing properties up to now have been mostly common-anion or common-cation heterostructures, where the band offsets are localized either in the conduction band or in the valence band. This paper deals with a leakage current in this sort of p-i-n heterostructure under forward bias. It is shown that the leakage current does not necessarily depend on the band offset, but principally depends on the energy-gap difference between the active layer and the cladding layer. This result leads to the expectation that the above heterostructures with the nearly flat band structures either in the conduction band or in the valence band will be applicable as II-VI laser materials. Quantitative comparison between the radiative recombination current and the leakage current was also performed on the laser diode structure. Author

A92-33140

CHARACTERISTICS OF A FAR-INFRARED MOLECULAR LASER OPTICALLY PUMPED BY A HIGH-POWER CO₂ LASER

T. HORI and N. HIROMOTO (Communications Research Laboratory, Koganei, Japan) *International Journal of Infrared and Millimeter Waves* (ISSN 0195-9271), vol. 13, April 1992, p. 483-496. refs

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The design and performance are described for a molecular FIR laser pumped by CO₂ that can be used for testing detectors and mixers or for FIR spectroscopy. The schematic configuration of the high-power FIR laser system is delineated with attention given to amplitude stability, short-term spectral linewidth, and center-frequency stability. The CO₂ laser used as the pumping source has a maximum power of over 100 W, and the beam is introduced through the input coupler. The FIR output power exceeds about 20-30 mW at frequencies of 580 GHz to 4.25 THz and pumping powers of between approximately 35 and 81 W. Amplitude stability of + or - 3 percent is demonstrated for about 30 min when the FIR tube is cooled to 5 C. Schottky barrier diodes are used to detect FIR laser lines of up to 4.25 THz and to measure the absolute frequency stability of HCOOH oscillation

at 693 GHz. The diodes can be used for detection at up to 4.3 THz, and the results show an inverse 4th-power law of responsivity vs frequency. C.C.S.

A92-33159

TEMPORAL BEHAVIOR OF POPULATION DENSITIES OF V ATOMS IN AN OPTICALLY PUMPED V VAPOR LASER

H. NINOMIYA, H. YOSHIDA, and N. TAKASHIMA (Shikoku Research Institute, Inc., Matsuyama, Japan) *Journal of Applied Physics* (ISSN 0021-8979), vol. 71, April 1, 1992, p. 3181-3185. refs

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The time variation of population densities of V atoms in absorption levels pertinent to an optically pumped atomic V vapor laser is studied experimentally. V vapor is generated from a V metal by irradiation of a pulsed Nd:YAG (1.06 micron) laser of 2 J/pulse energy and 1.4 ms pulse duration. The population densities of the ground-state and excited-state (E about 2400/cm) V atoms have been measured by the interferometric method, and the temperature in the vapor is estimated from these populations. It has been experimentally observed that the populations of the ground state and the excited state are about $1 \times 10^{14}/\text{cu cm}$ and $4 \times 10^{13}/\text{cu cm}$, respectively. The temperature in the vapor increased from about 1800 to 4000 K with time during the YAG laser irradiation. Author

A92-33468

GENERATION OF RELATIVISTIC PHOTOELECTRONS INDUCED BY AN ULTRAVIOLET LASER AND THEIR PROPAGATION CHARACTERISTICS IN A LONGITUDINAL GUIDING MAGNETIC FLUID

Y. KAWAMURA, K. TOYODA (Institute of Physical and Chemical Research, Wako, Japan), and M. KAWAI (Tokai University, Hiratsuka, Japan) *Journal of Applied Physics* (ISSN 0021-8979), vol. 71, March 15, 1992, p. 2507-2512. refs

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A92-35895

LOW-THRESHOLD GAINASP/INP TRANSMISSION-TYPE SURFACE EMITTING LASER

SHINICHI KUBOTA, FUMIO KOYAMA, and KENICHI IGA (Tokyo Institute of Technology, Yokohama, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L175, L176. refs

(Contract MOESC-03244105)

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Results of a demonstration of a transmission-type 1.3-micron GaInAlP/InP surface-emitting laser are presented. A threshold current density as low as 530 A/sq cm (I_{th} = 2.8 mA) was obtained under 77-K CW conditions; this is the lowest value of 1.3-micron surface emitting lasers ever reported. Some detailed spectral characteristics near the threshold were measured, and the possibility of narrow-band active vertical-cavity filters is suggested. P.D.

A92-36064

ROTATIONAL TEMPERATURE, INVERSION DENSITY AND ABSOLUTE POPULATION DENSITY FOR THE CO₂ (00(0)2) SEQUENCE BAND LASER

FUMIKO O. SHIMIZU, TADAHITO FUJISAWA, YASUHIKA YOKOYAMA, HIROKI TAKAHASHI, MARIKO HARA (Sophia University, Tokyo, Japan), and ARIMICHI MINOH (Institute of Physical and Chemical Research, Wako, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 2A, Feb. 1992, p. 274-280. Research supported by MOESC. refs

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Accurate values of the physical parameters such as rotational temperature, inversion density, absolute population density in the regular, and (00(0)2) sequence bands of the CO₂ laser have been determined. Those parameters characterize the lasing processes and interference between both bands. The dependences of the parameters on the partial pressures of foreign gas and the effects of foreign gas are also examined. It is confirmed that the rotational

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temperature is always well defined in any vibrational state. However, they are not necessarily equal to each other and to the translational temperature. Author

A92-36066

ADVANTAGE OF STRAINED QUANTUM WIRE LASERS

SHIN-ICHI UENO, YASUNARI MIYAKE, and MASAHIRO ASADA (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 2A, Feb. 1992, p. 286, 287. Research supported by MOESC and TEPCO Research Foundation. refs

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It is shown theoretically that the strained quantum wire (QW) lasers have gain and differential gain much larger than those of unstrained QW lasers. Application of the strain effect to quantum wire structure leads to small hole effective mass which induces a large separation between quantized energy levels in the valence band. Thus, holes concentrate efficiently into fundamental level, giving rise to increase of gain and differential gain. The wire width at which the energy separation is comparable to the thermal energy and the relaxation broadening is 2.5 times that of the unstrained case. Broadening of energy levels due to wire width fluctuation can be reduced 1/2 times that of the unstrained case. Author

A92-36935

EFFECT OF ELECTRICAL PARTITION NOISE ON SQUEEZING IN SEMICONDUCTOR LASERS

YOSHIIHISA YAMAMOTO (NTT, Basic Research Laboratories, Musashino, Japan) and HERMANN A. HAUS (MIT, Cambridge, MA) Physical Review A (ISSN 1050-2947), vol. 45, no. 9, May 1, 1992, p. 6596-6604. refs

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Amplitude fluctuations in the light from a laser and the partition noise attributable to a beam splitter are analyzed using an equivalent-circuit model that incorporates amplitude squeezing. When the energy is not carried by photons but by electrons and also when electrons can be treated as classical particles, the circuit model need not be changed. The general circuit model is applied to low frequencies. Conversion of an electric current to photon flux and vice versa converts classical sub-shot-noise character of electric currents, unlike that of quantum squeezing, is not necessarily destroyed by current loss. Author

A92-37179

HIGH-POWER INDIVIDUALLY ADDRESSABLE MONOLITHIC FOUR-BEAM ARRAY OF GaAlAs WINDOW DIFFUSION STRIPE LASERS

KUNIIHIKO ISSHIKI, AKIHIRO TAKAMI, SHOICHI KARAKIDA, TAKESHI KAMIZATO, SHOICHI KAKIMOTO, and MASAO AIGA (Mitsubishi Electric Corp., Optoelectronics and Microwave Devices Laboratory, Itami, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 4, April 1992, p. 804-810. refs

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A window structure has been applied, for the first time, to the individually addressable monolithic array of GaAlAs high-power lasers. A 100-micron spaced array of four window diffusion stripe lasers with a long-cavity of 600 microns has been fabricated by controllable open-tube two-step diffusion and single-step metalorganic chemical vapor deposition. The window structure and the p-type active stripes with a sufficiently narrow width around 2 microns are formed by diffusion of zinc, which just passes through an n-type active layer. CW output power up to 120 mW without catastrophic damage and a threshold current around 30 mA have been achieved for each element in the wavelength range of 830 nm. Excellent uniformity of device characteristics across an array chip is confirmed. Thermal crosstalk of the elements operating simultaneously is investigated. I.E.

A92-37205

EFFICIENT Nd:YAG LASER END-PUMPED BY A 1 CM APERTURE LASER-DIODE BAR WITH A GRIN LENS ARRAY COUPLING

SATOSHI YAMAGUCHI and HIROFUMI IMAI (Nippon Steel Corp.,

Electronics Research Laboratories, Sagamihara, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 4, April 1992, p. 1101-1105. refs

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A 10-W laser-diode bar, a multistripe monolithic laser-diode array, has been used to end-pump Nd:YAG. Twenty beams emitted from 20 stripes, spaced 500 microns apart, of a 1-cm linear diode array were collimated by a 1-cm-wide lens array consisting of 20 GRIN (graded-index) lenses with a width of 500 microns to pump the Nd:YAG facet. The maximum Nd:YAG CW output power at 1064 nm of 3.24 W CW was obtained at 8.6 W incident pump power with a total electrical-to-optical conversion efficiency of 10.1 percent, a threshold of 0.6 W, a maximum slope efficiency of 45 percent, and a single-lobed spatial mode. I.E.

A92-37211

LASER-DIODE-PUMPED PHASE-LOCKED Nd:YAG LASER ARRAYS

MICHIO OKA, HISASHI MASUDA, YUSHI KANEDA, and SHIGEO KUBOTA (Sony Corp., Kubota Optoelectronics Laboratory, Tokyo, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 4, April 1992, p. 1142-1147. refs

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Scaling of an efficient and compact diode-end-pumped Nd:YAG laser was demonstrated by two-dimensional phase-locked arrays. The arrays of stable resonators were formed by multiple thermal lenses induced by the simultaneous end-pumping of laser-diode-coupled fibers. Because of partial overlap of each transverse mode, the output was phase locked. Various configurations of pumping fibers were tested to study phase locking. It was found that minimization of the coherently coupled intensity between adjacent array elements have good prediction for phase difference between modes. When the plane parallel cavity as long as 30 mm was pumped by 2 x 2 laser diode coupled fibers, phase-locked 1.8-W continuous wave 1.06-micron output was obtained with 55 percent slope efficiency. The 1.2-W single longitudinal mode output with single-lobe beam profile was obtained by using a spatial phase filter and the twisted mode method. I.E.

A92-37214

LOW-NOISE OPERATION OF A DIODE-PUMPED INTRACAVITY-DOUBLED Nd:YAG LASER USING A BREWSTER PLATE

HIDEO NAGAI, MASAHIRO KUME, ISSEY OHTA, HIROKAZU SHIMIZU, and MASARU KAZUMURA (Matsushita Electronics Corp., Electronics Research Laboratory, Takatsuki, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 4, April 1992, p. 1164-1168. refs

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The authors demonstrate noise reduction which has been attained in a diode-pumped intracavity-doubled Nd:YAG laser by using a novel birefringent filter formed by a Brewster plate and a birefringent KTP crystal. It is confirmed that single longitudinal mode operation is obtained by the birefringent filter. As a result, the relative intensity noise obtained is less than -135 dB/Hz. This noise reduction technique should play an important role for application of laser-diode pumped intracavity-doubled solid-state lasers. I.E.

A92-37294

ADVANCED SEMICONDUCTOR LASERS

YASUHARU SUEMATSU (Tokyo Institute of Technology, Japan), KENICHI IGA (Tokyo Institute of Technology, Yokohama, Japan), and SHIGEHISA ARAI (Tokyo Institute of Technology, Japan) IEEE, Proceedings (ISSN 0018-9219), vol. 80, no. 3, March 1992, p. 383-397. Research supported by MOESC. refs

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Recent research activities in the field of advanced semiconductor lasers are reviewed with emphasis on highly stable single-wavelength lasers and surface-emitting (SE) lasers for wideband lightwave communication systems and optical parallel information processing. The operational characteristics of DSM (dynamic single-mode) lasers are summarized and requirements

for high-performance operation as light sources for high-speed transmission or coherent communications are described. A type of DSM laser called the distributed-reflector (DR) laser is described as an advanced DSM laser which enables high efficiency, high power, and narrow linewidth operations. Specific features and the potential of SE lasers are summarized. Research activities and remaining problems to be solved for a breakthrough in optical parallel information processing are presented. The potential of multidimensional quantum-well structures, such as QW lasers and quantum-box lasers, is discussed in terms of superior characteristics in both stationary and dynamic operations. The present fabrication technologies for realizing high-performance lasers based on multidimensional QW structures are also presented. I.E.

A92-37353

FABRICATION OF ZNCDSSE ALLOYS BY MOMBE AND THEIR APPLICATIONS FOR DOUBLE-HETERO AND QUANTUM-WELL STRUCTURES

KUNIO ICHINO, YI-HONG WU, YOICHI KAWAKAMI, SHIZUO FUJITA, and SHIGEO FUJITA (Kyoto University, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 527-531. Research supported by Nippon Sheet Glass Memorial Foundation and Nissha Aid for Academic Research. refs (Contract MOESC-02452147) Copyright

The utilization of a ZnCdSSe quaternary alloy system as a material for a laser diode (LD) operating in the blue-green to ultraviolet spectral region is proposed. High quality cubic-structured ZnCdSSe quaternary alloys have been grown on a GaAs substrate by metalorganic molecular beam epitaxy (MOMBE). Optically pumped lasing action peaking at the vicinity of 465 nm at 70 K have been achieved by multilayered structures using ZnCdSSe alloys. Author

A92-37691

EFFECTS OF DISLOCATION AND STRESS ON CHARACTERISTICS OF GAAS-BASED LASER GROWN ON SI BY METALORGANIC CHEMICAL VAPOR DEPOSITION

TAKASHI EGAWA, YOSHIAKI HASEGAWA, TAKASHI JIMBO, and MASAYOSHI UMENO (Nagoya Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 791-797. refs Copyright

The thermally induced biaxial tensile stress in GaAs/Si is reduced by postgrowth patterning, and the reduction in stress is dependent on the pattern size and shape. For narrow stripe patterns the stress relief is obtained perpendicular to the stripe. For small square patterns the stress is relieved in both directions. Thermal-cycle annealing is also effective in reducing the threading dislocations in GaAs/Si. A thermally cycle-annealed multi-quantum-well (MQW) laser on an Si substrate grown by metalorganic chemical vapor deposition has continuous threshold current as low as 24 mA at 300 K. Rapid degradation can be suppressed by postgrowth patterning for the thermally cycle-annealed laser with an 8-micron-wide stripe, which results from the reduction of the biaxial stress to the uniaxial stress. Author

A92-37692

ANALYSIS OF EFFECTIVE INTERACTION LENGTH FOR CROSSING BEAMS IN A PARA-HYDROGEN RAMAN LASER

AKIRA TSUNEMI, KEIGO NAGASAKA (Tokyo, Science University, Japan), and HIDEO TASHIRO (Institute of Physical and Chemical Research, Wako, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 805, 806. refs Copyright

Gains related to crossing interaction are studied experimentally in the pump and Stokes beams at a small crossing angle of stimulated rotational Raman scattering in parahydrogen. A

beam-crossing model is developed in which plane waves and uniform spatial distributions are assumed for intensity profiles around the crossing point. The study demonstrates the relationships between gains by crossing interaction and laser applications of multiple pass cells with a number of crossings. C.C.S.

A92-37693

OPTICAL AND THERMAL PROPERTIES OF SULFUR-PERTURBED F2(+) CENTERS IN NaCl AS THE LASER ACTIVE CENTER

YOSHIRO SUZUKI, TATSUHIKO SAITOH, KEN OZAWA, YASUHIRO KONDO, and MASAMITSU HIRAI (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 809-815. Research supported by MOESC. refs Copyright

The optimum sample preparation, optical properties, and stability against light and heat for sulfur-perturbed F2(+) centers F2(+):S(2-) in NaCl are investigated to determine the potential quality as a laser material. F2(+):S(2-)s were introduced into NaCl doped with Na2S by additive coloration and subsequent photoaggregation. Absorption and luminescence bands occurred at 1.18 and 0.832 eV at 80 K, respectively. The excitation spectra for the luminescence showed two maxima at 1.18 and 2.71 eV. The luminescence efficiency was 0.84 +/- 0.03 between 80 and 290 K. Photoexcitation of the F2(+) center in F2(+):S(2-) to the 2p(pi)(v) state at 80 K converted the configuration of F2(+):S(2-) into the most compact form, and also rotated the F2(+) axis by 60 degrees, while the photoexcitation above about 190 K destroyed F2(+):S(2-). F2(+):S(2-) was expected to be stable for about 19 days at 290 K, and about 400 days at 268 K in the dark. Author

A92-37699

LASER COOLING AND TRAPPING OF ALKALINE EARTH ATOMS

TAKAYUKI KUROSU and FUJIO SHIMIZU (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 908-912. refs (Contract MOESC-01060001) Copyright

Characteristics of laser trapping of Ca and Sr are experimentally studied and discussed. The lifetime of the trap is found to be limited by accumulation of the population in the (P-3)2 state, not by the decay (P-1)1-(D-1)2. This result permits the generation of a continuous free-falling flow of ultracold ground-state atoms which is useful for ultrahigh-resolution spectroscopy. Effects of an optical pumping laser which recycles the (D-1)2 population in Sr are investigated. Author

A92-37800

CROSSED-BEAM STUDY OF INITIAL VIBRATIONAL DISTRIBUTION OF KRF EXCIMER PRODUCED IN THE REACTION OF KR* + F2

HARUKO KOMATSU (Tokyo Gakuji University, Koganei, Japan), SATORU S. KANO (IBM Japan, Ltd., Tokyo Research Laboratory), HIROSHI TAKUMA, and TADAO SHIMIZU (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 3B, March 1, 1992, p. L280-L282. refs Copyright

The reaction of metastable Kr with F2 to form KrF excimer is studied using the crossed-molecular-beam technique. An emission spectrum of KrF* is obtained in the 210-265 nm region. The spectrum appreciably differs from a previous one that has been obtained in a flowing afterglow experiment. The vibrational distribution of KrF* formed by the crossed beam is well described by a linear surprisal distribution with lambda(v) = -4.0, while that from the flowing afterglow has been described with lambda(v) = -2.5. It is found that vibrational levels with v = 50-90 are highly populated. Author

A92-38059

METHOD FOR PUMPING A TI:SAPPHIRE LASER WITH A STABLE RESONATOR COPPER VAPOR LASER

K. TAKEHISA and A. MIKI (Hitachi, Ltd., Hitachi Research Laboratory, Japan) *Applied Optics* (ISSN 0003-6935), vol. 31, no. 15, May 20, 1992, p. 2734-2737. refs
Copyright

An average laser power of more than 3W and a slope efficiency of 20 percent are obtained with a Ti:sapphire laser oscillator pumped by a copper-vapor laser (CVL). A center-hole reflector inside a near-concentric resonator, instead of a dichroic mirror, makes it possible to utilize the stable resonator CVL as a pump source. Author

A92-38836

A GAINASP/INP GRATING FILTER MULTIPLE-STRIPE LASER ARRAY OPERATING IN IN-PHASE LATERAL- AND SINGLE-LONGITUDINAL-MODE

JIE DONG, TETSU IKEDA, SHIGEHISA ARAI, and KAZUHIRO KOMORI (Tokyo Institute of Technology, Japan) *IEEE Photonics Technology Letters* (ISSN 1041-1135), vol. 4, no. 5, May 1992, p. 491-494. Research supported by MOESC. refs
Copyright

The in-phase lateral- and single-longitudinal-mode operation of a 1.5-microns GaInAsP/InP laser array was demonstrated. The array consists of a positive-index-guide multiple-stripe array region and an unguided grating filter region. The advantage of this laser array is experimentally confirmed by comparing with the multiple-stripe DFB type laser array without the grating filter. I.E.

A92-38963

PROPOSAL AND REALISATION OF NEW TYPE DISTRIBUTED REFLECTOR LASER WITH MULTIQUANTUM-WELL STRUCTURE

J. I. SHIM, T. NOMAGUCHI, K. KUDO, and S. ARAI (Tokyo Institute of Technology, Japan) *Electronics Letters* (ISSN 0013-5194), vol. 28, no. 8, April 9, 1992, p. 741, 742. Research supported by MOESC. refs
Copyright

A new type of distributed reflector (DR) laser which uses the multi-quantum well (MQW) waveguide as both the active and passive distributed reflector is proposed and realized. Its superior lasing characteristics are experimentally confirmed by introducing Ga(x)In(1-x)As/GaInAsP compressive strained MQW layers; the characteristics include a narrow linewidth of 743 kHz, high submode suppression ratio of over 41 dB at 2.2 times the threshold, and about two times larger differential quantum efficiency than that of DFB lasers. Author

A92-39914

MOVEMENT OF MICROMETER-SIZED PARTICLES IN THE EVANESCENT FIELD OF A LASER BEAM

SATOSHI KAWATA and TADAO SUGIURA (Osaka University, Suita, Japan) *Optics Letters* (ISSN 0146-9592), vol. 17, no. 11, June 1, 1992, p. 772-774. Research supported by MOESC. refs
Copyright

It is reported that small particles with diameters of 1-27 microns have moved in the evanescent fields produced by a laser beam. The evanescent field in the experiment was produced in the near field of the surface of a high-refractive-index sapphire prism illuminated by a 1.06-micron YAG laser beam with an incident angle larger than the critical angle. Both polystyrene latex spheres and glass spheres bounced and ran along the surface of the prism when the laser beam was on. The maximum running speed obtained was approximately 20 microns/s. A micrograph of the running particles is shown with plots of the measured velocity versus the incident angle of the laser beam. Author

A92-40209

SPONTANEOUS EMISSION FACTOR OF A MICROCAVITY DBR SURFACE EMITTING LASER. II - EFFECTS OF ELECTRON QUANTUM CONFINEMENTS

TOSHIHIKO BABA, TETSUKO HAMANO, FUMIO KOYAMA, and KENICHI IGA (Tokyo Institute of Technology, Japan) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, no. 5, May

1992, p. 1310-1319. refs

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A method for the theoretical analysis of the spontaneous emission factor (C factor) has been developed for microcavity DBR surface emitting lasers having various quantum-well active regions. It is shown that the C factor can be enlarged by the enhancement of mode density, the anisotropic emission, and the narrow spectral width in quantum wells. C of about 0.6 may be obtained with GaAs-AlAs DBR's, 0.55 micron x 0.55 micron cross section of the cavity, three times vertically long cross section of quantum-wire active regions, and the spectral width of several nanometers at room temperature. This value can be further increased by utilizing a narrower spectral width expected at low temperature. For bulk and quantum film, the upper limit of the C factor is considered to be 0.5 due to the 50 percent probability of radiation energy coupled into one linearly polarized lasing mode. By the polarization selectivity of quantum wires, this limit can be enhanced to nearly 0.9, which is promising for the realization of thresholdless lasers. Author

A92-40213

A TUNABLE WAVELENGTH-CONVERSION LASER

KENTARO KONDO (Fujitsu Laboratories, Ltd., Atsugi, Japan), MASAOKI KUNO (Fujitsu, Ltd., Kawasaki, Japan), SHIGENOBU YAMAKOSHI, and KIYOHIDE WAKAO (Fujitsu Laboratories, Ltd., Atsugi, Japan) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, no. 5, May 1992, p. 1343-1348. refs
Copyright

A novel wavelength-conversion laser was fabricated using monolithic integration of a bistable laser diode and a wavelength-tunable distributed Bragg reflector (DBR) laser. This device converts an input light signal with a certain wavelength to output light with a tunable wavelength over 3.5 nm. Input power required for switching is investigated, and its resonant dependence on input wavelength is revealed. Input polarization is also discussed, and suppression of crosstalk is demonstrated. This device's turn-off switching response is greatly influenced by the light power of the input signal as well as bias current, and the first 1 Gb/s operation is achieved in optimum conditions for fast turn-off and stable turn-on. Author

A92-40259

NONLINEAR OPERATIONS OF 1.55-MICRON WAVELENGTH MULTIELECTRODE DISTRIBUTED-FEEDBACK LASER DIODES AND THEIR APPLICATIONS FOR OPTICAL SIGNAL PROCESSING

MASAHICO JINNO and TAKAO MATSUMOTO (NTT, Transmission Systems Laboratories, Yokosuka, Japan) *Journal of Lightwave Technology* (ISSN 0733-8724), vol. 10, no. 4, April 1992, p. 448-457. refs

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The nonlinear behavior of inhomogeneously excited 1.55-micron-wavelength multielectrode distributed-feedback laser diodes, such as self-pulsation and multistability for both injection current and for injection light is described. Wavelength bistability is also described. Optical signal processing applications are experimentally demonstrated including optical logic circuits, optical memories, an optical demultiplexer, an optical timing extractor, and optical regenerative repeaters. Author

A92-41501

DEVELOPMENT OF A HIGH POWER VACUUM ULTRAVIOLET F2 LASER (157 NM) EXCITED BY AN INTENSE ELECTRIC DISCHARGE

MASAYUKI KAKEHATA, ETSU HASHIMOTO, FUMIHIKO KANNARI, and MINORU OBARA (Keio University, Yokohama, Japan) *IN: Lasers '90; Proceedings of the 13th International Conference on Lasers and Applications, San Diego, CA, Dec. 10-14, 1990. McLean, VA, STS Press, 1991, p. 457-461. refs*
Copyright

The highest specific F2 laser energy of 2.9 J/I has been obtained by exciting a 10-atm F2/He mixture at an excitation power density of 66 MW/cm using a charge-transfer-type discharge

circuit. Frequency conversions by stimulated Raman scattering in H₂ have been demonstrated for the first time using this laser device. The first and second Stokes lines and the first anti-Stokes lines were observed. The energy conversion efficiencies at 10 atm H₂ were about 10 percent for the first Stokes, about 2 percent for the second Stokes, and about 0.8 percent for the first anti-Stokes. A substantial reduction in beam divergence was achieved without an external injection source by applying an unstable resonator to the F₂ laser. Laser etching of fluoride ethylene propylene film was demonstrated. C.D.

A92-41503

SUB-PS KRF LASER AND ITS APPLICATION FOR MULTI-PHOTON ABSORPTION MEASUREMENTS

H. NISHIOKA, T. KAWASUMI, K. UEDA, and H. TAKUMA (University of Electro-Communications, Chofu, Japan) IN: Lasers '90; Proceedings of the 13th International Conference on Lasers and Applications, San Diego, CA, Dec. 10-14, 1990. McLean, VA, STS Press, 1991, p. 529-535. refs
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A sub-picosecond KrF laser system free of amplified spontaneous emission has been developed. Two-step pulse shaping has been applied for efficient pulse compression in the high gain and low saturation fluence gain medium. Multiphoton absorption and the damage threshold were measured by photoacoustic detection. The correlation of damage threshold and bandgap energy leads to damage-resistant multilayered coatings. C.D.

A92-41598

FEEDBACK-CONTROLLED MODE-LOCKING OF ND:GLASS LASER USING GAAS

SHIGEICHI KUMAZAKI, VACLAV KUBECEK, YOSHIHIRO TAKAGI (Institute for Molecular Science, Okazaki, Japan), GIANCARLO C. REALI (Pavia, Università, Italy), and KEITARO YOSHIHARA (Institute for Molecular Science, Okazaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L413-L415. refs
Copyright

The passive negative feedback-controlled mode-locking operation of a Nd:glass laser using a GaAs wafer as an intracavity limiter is reported. A long pulse train extended up to 700 ns with a pulse duration of less than 3 ps was generated. The single-pulse energy was 60 microJ, which is six times higher than those of Nd:YAP (YAIO3) and Nd:YAG lasers. Author

A92-41954

GAIN MEASUREMENTS OF HIGH-PRESSURE ULTRAVIOLET-PREIONIZED SELF-SUSTAINED DISCHARGE PUMPED ATOMIC XENON LASER

KATSUHIKO KOMATSU, FUMIHIKO KANNARI, and MINORU OBARA (Keio University, Yokohama, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, no. 11, June 1, 1992, p. 5347-5352. refs
Copyright

To explore the laser kinetics of atomic xenon lasers pumped by an ultraviolet-preionized, self-sustained discharge, time-resolved small-signal gains are measured using a long-pulse probe laser. Faster electron mixing processes among excited xenon manifolds in the 6p state may affect the small-signal gain distribution among 1.73, 2.03, and 2.65-micron laser lines, which share the same upper laser level Xe(5d(3/2)i) at excitation rates in excess of 160 kW/cm². When the excitation rate in a late part of the discharge is increased, absorption caused by repumping of the lower laser level is observed at 1.73 micron. The measured gains are discussed in conjunction with multiline laser oscillation performance obtained by the same laser device. Author

A92-42397

SHOT-NOISE LIMITED LOW-FREQUENCY INTENSITY NOISE OF A ND:YAG LASER

KIMIO TSUBONO and SHIGENORI MORIWAKI (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN

0021-4922), vol. 31, no. 4, April 1992, p. 1241, 1242. Research supported by Matsuo Foundation. refs

Copyright

A method is proposed for intensity stabilization in a laser-diode pumped Nd:YAG laser. The relative-intensity fluctuation obtained using this method was less than $10 \exp^{-7} \text{ Hz} \exp^{-1/2}$ at frequencies between 100 Hz and 10 kHz, the level very close to the shot-noise limited value. This method may be of use for the development of ultrasensitive interferometric gravitational wave detectors. I.S.

A92-43206

DISTANCE AND ANGLE MEASURING METHOD USING LASER LIGHT AND REREFLECTION PLATES

NOBUO KAMATSU and S. TSUMURA (Osaka National University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 488-491. In Japanese. refs

The theory of using laser light and rereflection plates for distance and angle measurement is presented. The characteristics of the laser scanner are described. Y.P.Q.

A92-43911

PERFORMANCE OF COMPOSITE GLASS SLAB LASER

HIDEMI TAJIMA, MITSUHIKA MORIYAMA, NOBUYUKI TADOKORO, HIDEO HARA, and TAKAYASU MOCHIZUKI (Hoya Corp., Optronics Div., Akishima, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 6, June 1992, p. 1562-1570. refs
Copyright

The design and fabrication of three-layer composite glass-slab lasers is described with attention given to the development of a high-peak-power glass laser with high repetition rates. Attention is given to the trial manufacturing and optical characteristics of the composite glass, the design of the laser head, and the oscillation characteristics of the laser during single shots and repetitive operation. A simulation is conducted for comparison with experimental data on such parameters as temperature distribution, storage efficiency, and stress distribution. The glass slabs fabricated by thermal diffusion with LHG-5 laser glass and nondoped glass have thermal expansion efficiencies and refractive indices that compare well with those of LHG-5 laser glass. The composite slabs can reduce thermal birefringence effects and provide for increased thermal-fracture-limited average output power. C.C.S.

A92-45611

FREQUENCY NOISE REDUCTION OF A DIODE LASER BY USING THE FM SIDEBAND TECHNIQUE

K. NAKAGAWA, M. KUROGI, and M. OHTSU (Tokyo Institute of Technology, Yokohama, Japan) Optics Letters (ISSN 0146-9592), vol. 17, no. 13, July 1, 1992, p. 934-936. refs
(Contract MOESC-03250205)
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The frequency of a 1.5-micron three-electrode multiple-quantum-well distributed-feedback diode laser was stabilized to a reference Fabry-Perot cavity by using a current-modulated FM sideband technique. The low-frequency AM noise imposed on the frequency error signal was effectively reduced with this technique, and the power spectrum density of the FM noise was reduced to less than 25 Hz-squared/Hz at a Fourier frequency of less than 10 kHz, which corresponded to a Lorentz spectral half-linewidth of approximately 80 Hz. Author

A92-45963

OPTICAL LOGIC FUNCTIONS USING A TUNABLE WAVELENGTH CONVERSION LASER DIODE

HIROYUKI NOBUHARA, KENTARO KONDO, SHIGENOBU YAMAKOSHI (Fujitsu Laboratories, Ltd.; Optoelectronics Technology Research Corp., Atsugi, Japan), and KIYOHIDE WAKAO (Fujitsu Laboratories, Ltd., Atsugi, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 7, July

36 LASERS AND MASERS

1992, p. 1722-1726. refs

Copyright

Optical logic functions of an inverter (NOT) and an exclusive-OR (XOR) are demonstrated using a tunable wavelength conversion (TWC) laser diode developed as a component in optical wavelength division multiplexing (WDM). The TWC laser's optical functions are easily changed by varying bias current settings in gain sections. At just above the turnon threshold, the TWC laser acts as an optical inverter. At just below the turnoff threshold, it acts as an optical XOR element. The mechanism of both NOT and XOR operations is based on gain quenching accelerated through a saturable absorber, a major feature of the TWC laser. Single longitudinal-mode lasing and the tunability of the lasing wavelength, other features of the TWC laser, are effective in distinguishing lasing light signals from input light signals. This shows promise in using both lasing and amplified light as output signals for next-stage elements in projected WDM systems. Author

A92-46150

OPTICAL FIBER AMPLIFIERS

TETSUHIKO IKEGAMI and MOTOHIRO NAKAHARA (NTT, Opto-Electronics Laboratories, Tokai, Japan) IN: Physical concepts of materials for novel optoelectronic device applications II: Device physics and applications; Proceedings of the Meeting, Aachen, Federal Republic of Germany, Oct. 28-Nov. 2, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 350-360. refs

Copyright

Recent progress on an erbium-doped optical fiber amplifier (EDFA) pumped with a 0.98 micron laser diode is reported. An erbium-doped fiber with a very high gain coefficient of 11.0 dB/mW has been achieved using an extended VAD method. A high power 0.98 micron laser diode with a strained-layer InGaAs quantum well laser structure has been developed as the pumping light source. By employing these key components in the EDFA, a compact and highly efficient EDFA module has been fabricated successfully. The module size is only 36 cc. It attained a 33 dB net gain at 1.536 microns and it consumed only 175 mW of electricity. Author

A92-46239

TEMPERATURE AND MODULATION DEPENDENCE OF SPECTRAL LINEWIDTH IN DISTRIBUTED BRAGG REFLECTOR LASER DIODES

SHINZO SUZAKI, MASANORI ISHII, TSUTOMU WATANABE, and TAKAO SHIOTA (Fujikura, Ltd., Opto-Electronics Laboratory, Chiba, Japan) IN: Integrated optics and optoelectronics II; Proceedings of the Meeting, San Jose, CA, Sept. 17-19, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 126-131. refs

Copyright

The paper investigates the dependence of spectral linewidth for temperature and modulation in distributed Bragg reflector laser diodes. The spectral linewidth was measured by the delayed self-heterodyne method. It is proven that a rise in temperature and modulation frequency and modulation depth enhance the spectral linewidth. It is confirmed that there is a close relationship between environmental change and spectral linewidth. The variation of normalized spectral linewidth (NSL) was 2.0 MHz*mW/deg at 25 C. C.A.B.

A92-46968

INGAAS-GAAS-INGAP CHANNEL GUIDE STRAINED QUANTUM WELL LASERS WITH OUTPUT POWERS OVER 300 MW

Y. K. SIN, H. HORIKAWA, K. YAMADA, and T. KAMIJOH (Oki Electric Industry Co., Ltd., Semiconductor Technology Laboratory, Hachioji, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 13, June 18, 1992, p. 1234, 1235. refs

Copyright

Device results are reported from channel guide InGaAs-GaAs strained quantum well lasers ($\lambda = 980$ nm) with In(0.49)Ga(0.51)P cladding layers. AR-HR coated channel guide

lasers with a p-n-p InGaP current blocking junction on a p(+)-GaAs substrate show high output powers of 302 mW, which is the highest output power obtained from InGaAs-GaAs-InGaP lasers. Author

A92-47824

NONLINEAR BEHAVIOR OF TWIN-STRIPE SEMICONDUCTOR LASERS AND ITS APPLICATION TO OPTICAL LOGIC OPERATIONS

MASANOBU WATANABE Electrotechnical Laboratory, Researches (ISSN 0366-9106), no. 934, Jan. 1992, 97 p. In Japanese. refs

Results are presented on computed light-current nonlinearity of a twin-stripe laser with 2-micron-wide anode stripes separated by 3 microns. The mechanism of the nonlinearity including negative differential efficiency is explained on the basis of the peculiar lateral-mode behavior observed. The computed results, particularly on the mechanism of nonlinearity, are verified by experimental results including light current characteristics, near- and far-field patterns, and spectra measured systematically as functions of the injected-current ratio and the interstripe etching depth. The properties of an optical tristable device realized by adding a positive feedback circuit to a twin laser with light-current nonlinearity are described. Results of computer simulations show that a symmetrically pumped twin-stripe laser can generate cross-coupled lateral modes. I.S.

A92-48070

HIGHLY RELIABLE HIGH-POWER ALGAAS LASERS WITH WINDOW GROWN ON FACETS

K. SASAKI, M. MATSUMOTO, M. KONDO (Sharp Corp., Tenri, Japan), T. ISHIZUMI (Sharp Corp., Yamatokoriyama, Japan), T. TAKEOKA, H. NAKATSU, M. WATANABE, O. YAMAMOTO, S. YAMAMOTO, and T. HIJIKATA (Sharp Corp., Tenri, Japan) IN: Laser diode technology and applications IV; Proceedings of the Meeting, Los Angeles, CA, Jan. 20-22, 1992. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1992, p. 204-210. refs

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The paper discusses the characteristics of single-stripe AlGaAs high-power lasers with a novel window structure, named the 'window grown on facets (WGF)' (Sasaki et al., 1991), in which window layers are epitaxially grown on cleaved (110) facets, independent of the internal laser structure. The WGF technique was applied to the V-channeled substrate inner stripe (VSIS) lasers in the wavelength range 780-830 nm. Excellent high-power and high-reliability characteristics of the VSIS lasers with WGF structure were demonstrated. Results of reliability obtained at 100 mW (830 nm) and at 70 mW (at 780 nm) are considered of significance for the development of communications, SHG, and optical storage memory systems. I.S.

A92-48071

DEVICE-DEGRADATION PHENOMENA IN III-V SEMICONDUCTOR LASERS AND LEDS

OSAMU UEDA (Fujitsu Laboratories, Ltd., Atsugi, Japan) IN: Laser diode technology and applications IV; Proceedings of the Meeting, Los Angeles, CA, Jan. 20-22, 1992. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1992, p. 215-228. refs

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The current status and understanding of various degradation phenomena in III-V optoelectronic devices are discussed, with special consideration given to semiconductor lasers and light emitting diodes fabricated from GaAlAs/GaAs, InGaAsP/InP, and InGaAsP/InGaP/GaAs double-heterostructure materials. Three major degradation phenomena are discussed: rapid degradation, gradual degradation, and catastrophic failure. For each type of these degradation phenomena, methods for eliminating degradation are proposed. I.S.

A92-49590

HIGHLY STABLE OPERATION OF ALGAINP/GAINP STRAINED MULTIQUANTUM WELL VISIBLE LASER DIODES

J. HASHIMOTO, T. KATSUYAMA, J. SHINKAI, I. YOSHIDA, and H. HAYASHI (Sumitomo Electric Industries, Ltd., Optoelectronics Research and Development Laboratories, Yokohama, Japan) *Electronics Letters* (ISSN 0013-5194), vol. 28, no. 14, July 2, 1992, p. 1329, 1330. refs

Copyright

The long-term reliability of AlGaInP/GaInP strained multiquantum well (SMQW) lasers has been investigated. Highly stable operation with low operation current for more than 5500 h has been achieved under 50 C, 3 mW test conditions, without sudden or rapid failures due to strain induced defects. The estimated mean time to failure (MTTF) is 10,900 h, which is comparable to that of the conventional DH laser and long enough for practical use. Author

A92-49601

ETCHING AND OPTICAL CHARACTERISTICS IN GAAS/GAALAS SURFACE EMITTING LASER FABRICATION USING A NOVEL SPRAY ETCH

HIROMASA TANOBE, FUMIO KOYAMA, and KENICHI IGA (Tokyo Institute of Technology, Yokohama, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1597-1601. refs

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Results on a novel spray wet etch technique and surface characterization in forming short cavity structures for GaAs/GaAlAs vertical cavity surface emitting lasers are presented. The method produces no restriction on the etching reaction. Therefore, high uniformity and good flatness of the Ga(0.6)Al(0.4)As surface are simultaneously obtained. The flatness is within the range of the resolution-limited roughness, 10 Å. The optical flatness is similarly improved, which eliminates the output-side mirror loss of the SE laser. When this technique was applied to the fabrication of a short cavity GaAs/GaAlAs SE laser, reasonably good performance was observed for all lasers. P.D.

A92-49908

GAAS MICROCAVITY QUANTUM-WELL LASER WITH ENHANCED COUPLING OF SPONTANEOUS EMISSION TO THE LASING MODE

R. J. HOROWICZ, H. HEITMANN (NTT, Basic Research Laboratories, Musashino, Japan), Y. KADOTA (NTT, Optoelectronics Laboratories, Atsugi, Japan), and Y. YAMAMOTO (NTT, Basic Research Laboratories, Musashino, Japan) *Applied Physics Letters* (ISSN 0003-6951), vol. 61, no. 4, July 27, 1992, p. 393-395. refs

Copyright

Low-threshold lasing is observed in a GaAs single quantum-well vertical microcavity. At 4 K the quantum-well emission linewidth is reduced, and the coupling efficiency beta of the spontaneous emission to the lasing mode is improved. The laser threshold pump power obtained for a 200 Å GaAs quantum-well pumped by a continuous wave Ti:sapphire laser was 5 mW, corresponding to 85 microW absorbed power. The experimental results are compared with the theoretical prediction, and estimated the value of beta to be 0.01. Author

A92-50904

HIGH POWER SINGLE MODE OPERATION OF LONG CAVITY GAALAS LASERS WITH NONABSORBING MIRROR BURIED TWIN RIDGE SUBSTRATE STRUCTURE

H. NAITO, O. IMAFUJI, M. KUME, H. SHIMIZU, and M. KAZUMURA (Matsushita Electronics Corp., Takatsuki, Japan) *Applied Physics Letters* (ISSN 0003-6951), vol. 61, no. 5, Aug. 3, 1992, p. 515, 516. refs

Copyright

A 350 micron long cavity GaAlAs laser with nonabsorbing mirror buried twin ridge substrate structure has been developed, in order to obtain highly reliable high power single mode operation. It is found that the long cavity stabilizes lateral mode at powers higher than conventional maximum values because the carrier density is reduced to well suppress spatial hole-burning effect. The fundamental spatial mode operation is confirmed up to 210 mW

and the maximum output power as high as 380 mW is obtained. The lifetime at 100 and 200 mW at 25 C are expected to be 170,000 and 24,000 h, respectively, from the aging test results.

Author

A92-50988

LOW THRESHOLD INGAAS STRAINED QUANTUM WELL LASER WITH LATERAL NPN CURRENT BLOCKING STRUCTURE GROWN BY MOLECULAR BEAM EPITAXY

T. TAKAMORI, K. WATANABE, and T. KAMIJOH (OKI Electric Industry Co., Ltd., Hachioji, Japan) *Electronics Letters* (ISSN 0013-5194), vol. 28, no. 15, July 16, 1992, p. 1419, 1420. refs

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A sophisticated current confinement structure using the amphoteric nature of MBE grown Si-doped GaAs and AlGaAs is demonstrated for an index-guided InGaAs strained quantum well laser. Lateral and vertical npn current blocking layers were formed for the first time by a self-aligned process. Devices showed threshold current of 10 mA and total slope efficiency of 0.56 under room temperature CW operation. Author

A92-51021

HIGH-POWER, TUNABLE, HIGH-REPETITION-RATE TEA(C-13)(0-18)2 LASER

MASAKATSU SUGII, TAKAO KOMI, HIROSHI HARA, and HIROMICHI SHIRAHATA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, no. 8, Aug. 1992, p. 1754, 1755. refs

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The first demonstration of a power enhancement of a high-repetition-rate TEA(C-13)(0-18)2 laser by substitution of rare (N-15)2 isotope instead of (N-14)2 and its tunable single-mode operation is reported. An efficient, high-power operation with a maximum average power of 25 W (100 Hz) at a slope efficiency of 5.6 percent, which is improved by a factor of 2 by substitution of (N-15)2 instead of (N-14)2 has been successfully achieved from a discharge volume of 57.5 cu cm with an active length of 26 cm. In addition, its high-power, tunable, single-mode operation has been achieved with a three-mirror cavity consisting of two-mirrors and a Littrow grating. Author

A92-51024

PLASMA CHEMISTRY OF THE CLOSED-CYCLE 1 KHZ TRANSVERSELY EXCITED ATMOSPHERIC CO2 LASER WITH AN EFFICIENT CATALYTIC CO2 REGENERATOR

HIROKAZU HOKAZONO, NAOKI KOBAYASHI, MINORU OBARA (Keio University, Yokohama, Japan), KATSUMI MIDORIKAWA, and HIDEO TASHIRO (Institute of Physical and Chemical Research, Wako, Japan) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, no. 8, Aug. 1992, p. 1792-1797. refs

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A92-51235

Q-SWITCHED TUNABLE FORSTERITE LASER

YUSABURO SEGAWA, AKIKO SUGIMOTO (Institute of Physical and Chemical Research, Wako, Japan), and KIYOSHI YAMAGISHI (Mitsui Kinzoku, Core Technology Laboratory, Ageo, Japan) IN: *OSA Proceedings on Advanced Solid-State Lasers. Vol. 10 - Proceedings of the Topical Meeting, Hilton Head, SC, Mar. 18-20, 1991. Washington, DC, Optical Society of America, 1991, p. 49-51. refs*

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The tunable Q-switching operation of forsterite (Cr:Mg₂SiO₄) laser was demonstrated. The typical Q-switched pulse was 60 ns to 80 ns in width, varied with lasing wavelength. A smooth tuning curve that extends from 1206 nm to 1264 nm was obtained. Author

A92-51252

E/O Q-SWITCHING OF A FLASHLAMP-PUMPED TI:SAPPHIRE LASER

YUSABURO SEGAWA (Institute of Physical and Chemical

36 LASERS AND MASERS

Research, Wako, Japan), SEIJI ODA, and NOBUHIRO KODAMA (Tosoh Corp., Advanced Materials Research Laboratory, Kanagawa, Japan) IN: OSA Proceedings on Advanced Solid-State Lasers. Vol. 10 - Proceedings of the Topical Meeting, Hilton Head, SC, Mar. 18-20, 1991. Washington, DC, Optical Society of America, 1991, p. 149-152. refs

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Attention is given to the E/O Q-switching of a flashlamp pumped Ti:sapphire laser simulated by simple rate-equations. The peak power of this laser was observed to be almost four times as high as that of the normal oscillation at the most effective wavelength. Effective improvements are predicted for obtaining higher peak power. These include increased input power, reduced optical loss, and optimized output coupler. A 200-kW peak power laser would be obtained for an input of 900 J, with a 50-percent transmission coupler and a minimum optical loss cavity. P.D.

A92-51841

THRESHOLD AND MODULATION CHARACTERISTICS OF PHOTON-RECYCLED SEMICONDUCTOR LASERS

TAKEMASA TAMANUKI, FUMIO KOYAMA, and KENICHI IGA (Tokyo Institute of Technology, Yokohama, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1810, 1811. refs

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Threshold and modulation characteristics of semiconductor lasers using photon recycling are theoretically discussed. Threshold current in the closed cavity is reduced by a factor of more than three compared to that of the conventional open cavity. These results are applicable to large horizontal cavity lasers as well as amplifiers. If a low-loss closed microcavity with photon recycling and spontaneous emission control can be achieved, ultralow threshold or thresholdless operation may be expected. C.D.

A92-52252

1-KW, CAPACITIVELY COUPLED RADIO FREQUENCY DISCHARGE EXCITED CO LASER WITH A CLOSED-CYCLE FAST AXIAL FLOW

SHUNICHI SATO and MANABU TANIWAKI (Institute of Research and Innovation, Kashiwa, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 6, Aug. 10, 1992, p. 621-623. Research supported by Power Reactor and Nuclear Fuel Development Corp. refs

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A capacitively coupled transverse radio frequency discharge has been successfully applied to excite a CO laser with a closed-cycle fast axial flow. The discharge and laser characteristics are described and the role of the O₂ added to CO/N₂/He mixtures is discussed. For a mixture of CO/N₂/He/O₂ = 7.5/12.5/80/0.8 an output of about 1 kW has been obtained at an entrance gas temperature of 160 K. Stable output with good beam quality has been demonstrated. Author

A92-52500

TRANSMISSION OF KILOWATT-CLASS CO₂ LASER LIGHT THROUGH DIELECTRIC-COATED METALLIC HOLLOW WAVEGUIDES FOR MATERIAL PROCESSING

AKIHITO HONGO (Hitachi Cable, Ltd., Advanced Research Center, Japan), KEN'ICHI MOROSAWA, KAZUHISA MATSUMOTO, TSUNEO SHIOTA (Hitachi Cable, Ltd., Optoelectronic Systems Laboratory, Japan), and TAKASHI HASHIMOTO (Toyota Motor Corp., Motomachi Plant, Japan) Applied Optics (ISSN 0003-6935), vol. 31, no. 24, Aug. 20, 1992, p. 5114-5120. refs

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A92-53274

ADVANTAGES OF INGAASP SEPARATE CONFINEMENT LAYER IN 0.98 MICRON INGAAS/GAAS/INGAP STRAINED DQW LASERS FOR HIGH POWER OPERATION AT HIGH TEMPERATURE

M. SAGAWA, K. HIRAMOTO, T. TSUCHIYA, S. TSUJI, and K. UOMI (Hitachi, Ltd., Central Research Laboratory, Kokubunji,

Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 17, Aug. 13, 1992, p. 1639, 1640. refs

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The advantages of 0.98 micron InGaAs/GaAs/InGaP lasers with an InGaAsP SCH layer were investigated by comparing them with identical lasers with a conventional GaAs SCH layer. A higher internal quantum efficiency of 0.817 and low internal loss of 2.11/cm were obtained due to the large conduction band discontinuity. Moreover, high-power operation of 80 mW from an uncoated facet was obtained up to 70 C with the laser with the InGaAsP SCH layer. Author

A92-53791

HIGH-POWER CONTINUOUS-WAVE ULTRAVIOLET GENERATION BY FREQUENCY DOUBLING OF AN ARGON LASER

YOICHI TAIRA (IBM Research, Tokyo Research Laboratory, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6A, June 1, 1992, p. L682-L684. refs

Copyright

Continuous-wave 257-nm coherent light with a power of 1.2 W is generated by using an intracavity frequency doubling argon laser. In the last resonator, an elliptical focusing technique is employed to minimize the risk of optical damage to a beta barium borate (BBO) nonlinear optical crystal without sacrificing the frequency conversion coefficient. Author

A92-53983

THEORETICAL ANALYSIS OF DYNAMIC RESPONSE OF ASYMMETRIC DUAL QUANTUM WELL LASERS

SOTOMITSU IKEDA (Canon Research Center, Atsugi, Japan) and AKIRA SHIMIZU (Tokyo, University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 9, Aug. 31, 1992, p. 1016-1018. refs

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Dynamic responses of the photon and carrier densities in an asymmetric dual quantum well laser which exhibits wavelength switching are analyzed theoretically. The laser consists of two different quantum wells isolated by a high and/or thick barrier layer that results in an inhomogeneous carrier injection into the two wells. The calculated pulse response at a voltage of the dual-wavelength lasing shows that the emission of the shorter wavelength light precedes that of the longer wavelength light by a nanosecond, in agreement with recent experimental results. Author

A92-55008

ZNSE/ZNMGSSSE BLUE LASER DIODE

H. OKUYAMA, T. MIYAJIMA, Y. MORINAGA, F. HIEI, M. OZAWA, and K. AKIMOTO (Sony Corp., Research Center, Yokohama, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 19, Sept. 10, 1992, p. 1798, 1799. refs

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The continuous wave operation of an ZnSe/ZnMgSSe laser diode was achieved for the first time at 77 K. Blue stimulated emission was observed at a wavelength of 447 nm and the threshold current density was 225 A/sq cm. Author

A92-55014

LOW THRESHOLD FS-BH LASER ON P-INP SUBSTRATE GROWN BY ALL-MOCVD

Y. OHKURA, T. KIMURA, T. NISHIMURA, K. MIZUGUCHI, and T. MUROTANI (Mitsubishi Electric Corp., Optoelectronic and Microwave Devices Laboratory, Itami, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 19, Sept. 10, 1992, p. 1844, 1845. refs

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A novel FS-BH laser structure using the selective growth characteristics of MOCVD on crystal facets has been developed. A threshold current as low as 12mA and output power of 40mW under CW operation have been achieved in the laser. Author

A92-55985

**A 5 KW CW CO₂ LASER USING A NOVEL
NEGATIVE-BRANCH UNSTABLE RESONATOR WITH A
PHASE-UNIFYING OUTPUT COUPLER**

YUSHI TAKENAKA, MASAKI KUZUMOTO, and KOJI YASUI
(Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki,
Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197),
vol. 28, no. 9, Sept. 1992, p. 1855-1858. refs
Copyright

A 5 kW CW CO₂ laser using a novel negative-branch unstable resonator ($M = -1.5$) is proposed and characterized experimentally. The resonator consists of a stepwise variable reflecting output coupler termed phase-unifying output coupler and a total reflector. A 5 kW CW laser beam with diffraction limited quality ($2\theta = 0.45$ mrad) is obtained not affected by the focal point in the resonator. The misalignment angle to reduce the laser power to 95 percent is improved by a factor of 19 compared with a positive-branch unstable resonator ($M = 1.5$) with a phase-unifying output coupler at the same resonator length. Author

A92-55988

**NOISE STUDY OF LOW-DIMENSIONAL QUANTUM-WELL
SEMICONDUCTOR LASER AMPLIFIERS**

KAZUHIRO KOMORI, SHIGEHISA ARAI, and YASU HARU
SUEMATSU (Tokyo Institute of Technology, Japan) IEEE Journal
of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 9, Sept.
1992, p. 1894-1900. refs
(Contract MOESC-03452150; MOESC-03750235)
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The density matrix theory of semiconductor lasers is used to analyze and compare the noise characteristics of semiconductor laser amplifiers (SLAs) consisting of quantum-film, quantum-wire, and quantum-box structures. The analysis yields accurate expressions for stimulated emission rate, spontaneous emission rate, and population inversion parameter. It is shown that the signal-spontaneous beat noise can be reduced by using low-dimensional quantum-well structures due to smaller population inversion parameter and power loss of the waveguide. V.L.

A92-56591

**ESTIMATION OF THE RELIABILITY OF 0.98 MICRON
INGAAS/GAAS STRAINED QUANTUM WELL LASERS**

MASANOBU OKAYASU and MITSUO FUKUDA (NTT,
Opto-Electronics Laboratories, Atsugi, Japan) Journal of Applied
Physics (ISSN 0021-8979), vol. 72, no. 6, Sept. 15, 1992, p.
2119-2124. refs
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A reliability study has been made on 0.98 micron InGaAs/GaAs strained quantum well ridge waveguide lasers for pumping erbium-doped fiber optical amplifiers (EDFAs). Analysis of a constant power long-term aging test over 10,000h shows that the degradation rate is proportional to the square root of the aging time irrespective of operating output power. A simple relationship is found between degradation rate and both operation current density and optical density. The change in light-current characteristics and emission wavelength during constant current aging are also investigated. It is found that emission wavelength exhibits a blue shift for an identical operation current accompanied by laser degradation due to an increased threshold carrier density. Author

A92-56601

**ADDING A HEAT BYPASS IMPROVES THE THERMAL
CHARACTERISTICS OF A 50-MICRON SPACED 8-BEAM
LASER DIODE ARRAY**

SETSU KO MURATA and HIROSHI NAKADA (NTT, Interdisciplinary
Research Laboratories, Musashino, Japan) Journal of Applied
Physics (ISSN 0021-8979), vol. 72, no. 6, Sept. 15, 1992, p.
2514-2516. refs
Copyright

Because heat transferred between closely spaced elements in a compact laser diode array shortens array lifetime and affects the elements' operating characteristics, we evaluated the effect

of a heat-bypass structure by measuring the thermal resistance of array elements. We estimated thermal resistance by measuring differences between junction voltage before and after injecting subthreshold current pulses. The thermal resistances due to self heating were more than 20 percent lower after adding the heat-bypass structure. This effect was greatest for elements whose thermal resistance was initially highest, and it was proportional to the number of operating elements. The bypass structure therefore also reduced the thermal resistance resulting from simultaneous operation of all eight elements by more than 40 percent. The resultant reduction in the junction temperature of array elements operating at 100 mW would increase array lifetime at least threefold. Author

N92-10189# Tokyo Univ. (Japan). Inst. of Space and
Astronautical Science.

**LASER INTERFEROMETER (TENKO-10 AND -100) FOR
GRAVITATIONAL WAVE ANTENNA DEVELOPMENT**

NOBUKI KAWASHIMA Jul. 1991 15 p
(ISSN 0285-6808)

(ISAS-640) Avail: CASI HC A03/MF A01

Development of 10 m 102 bounce laser interferometer gravitational wave antenna (TENKO-10) at ISAS is described. The objective is to establish the engineering background for the laser interferometer gravitational wave antenna in Japan so that a km class antenna can be constructed for the detection of gravitational waves in the future. A particular emphasis was on the achievement of a long term stable operation, 127 hour operation was realized in Feb. to Mar. 1989 and more than 5 hour continuous operation was done without any adjustment. An upgrade of the interferometer to 100 m (TENKO-100) is going to be started in 1991 and will be completed in 1994. Author

N92-15380# Nagoya Univ. (Japan). Plasma Science Center.

**TWO-FREQUENCY OPERATION OF A HYBRID TEA CO₂
LASER AND ITS APPLICATION TO TWO-FREQUENCY PULSE
INJECTION LOCKING**

KOICHI SASAKI (Nagoya Univ. (Japan).), HIROTAKA OHNO
(Nagoya Univ. (Japan).), TAKAHARU FUJII (Nagoya Univ., Japan
) and TAKASHIGE TSUKISHIMA Oct. 1990 16 p
(DE91-780195; PSC-11) Avail: CASI HC A03/MF A01

Simultaneous two-frequency oscillation of a hybrid TEA CO₂ laser is exhibited when the cw section is operated in a 'below threshold' state. The output of the hybrid laser thus obtained is injected into a main TEA CO₂ laser to obtain a power-modulated, long-pulsed output with a well suppressed gain-switched spike. DOE

**N92-16292# Japan Atomic Energy Research Inst., Ibaraki.
ENERGY CONVERSION EFFICIENCY IN HIGH CURRENT
RAMAN-REGIME FREE-ELECTRON LASER, PART 2**

YASUAKI KISHIMOTO, MAKOTO SHIHO, and HISAKO ODA Nov.
1990 31 p In JAPANESE; ENGLISH summary
(DE91-780209; JAERI-M-90-211) Avail: CASI HC A03/MF A01

Parasitic wave excitation in a Raman-regime free-electron laser (FEL) has been investigated by using a one dimensional multi-frequency amplification code. It was found that multi-mode coupling among sideband waves and the primary wave plays an important role in the parasitic wave excitation in addition to the sideband instability. Here, we describe the details of the numerical calculation and study the underlying physical mechanisms leading to the observed results. The origin of the new wave excitation by the multi-mode coupling is found to be a forced oscillation due to the transverse nonlinear current produced by the mode coupling. An additive law for the growth rate of parasitic waves is analytically deduced. DOE

N92-16293# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear
Study.

**AN INTENSE POLARIZED BEAM BY A LASER IONIZATION
INJECTION**

CHIIHIRO OHMORI, SHIGENORI HIRAMATSU, and TAKESHI

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NAKAMURA Dec. 1990 7 p
(DE91-780368; INS-857) Avail: CASI HC A02/MF A01

Accumulation of protons and polarized protons by photo-ionization injection are described. This method consists of: (1) producing the neutral hydrogen beam by Lorentz stripping; (2) excitation of the neutral hydrogen beam with a laser; and (3) ionization of the hydrogen beam in the 2P excited state with another laser. When the laser for the excitation is circularly polarized, we can get a polarized proton beam. An ionization efficiency of 98 percent and a polarization of 80 percent can be expected by an intense laser beam from a free electron laser (FEL). DOE

N92-16306# Japan Atomic Energy Research Inst., Tokyo.
INITIAL EXPERIMENT OF FOCUSING WIGGLER OF MM WAVE FREE ELECTRON LASER ON LAX-1

KEISHI SAKAMOTO (Japan Atomic Energy Research Inst., Ibaraki.), SUNAO MAEBARA (Japan Atomic Energy Research Inst., Ibaraki.), AKIHIKO WATANABE (Japan Atomic Energy Research Inst., Ibaraki.), YASUAKI KISHIMOTO (Japan Atomic Energy Research Inst., Ibaraki.), TAKASHI NAGASHIMA (Japan Atomic Energy Research Inst., Ibaraki.), HIKOSUKE MAEDA (Japan Atomic Energy Research Inst., Ibaraki.), MAKOTO SHIHO (Japan Atomic Energy Research Inst., Ibaraki.), HISAKO ODA (Japan Atomic Energy Research Inst., Ibaraki.), and SUNAO KAWASAKI (Saitama Univ., Urawa, Japan) Mar. 1991 16 p
(DE91-522047; JAERI-M-91-036) Avail: CASI HC A03/MF A01

Initial results of Free Electron Laser (FEL) experiment in the mm wave region are presented. The experiment is carried out using an induction linac system (LAX-1: Large Current Accelerator Experiment) of $E(\text{sub } b) = 1 \text{ MeV}$, $I_b = 1$, approximately 3 kA. The wiggler of FEL is composed of the curved surface magnets arrays (focusing wiggler), which is found to be effective for a transport of low energy and high current beam through the wiggler. The super radiance of the mm wave region (30-40 GHz) is observed. The growth rate of this radiation is 0.42 dB/cm. DOE

N92-31029*# Hamamatsu Photonics K. K., Ichino (Japan).
A GEODETIC LASER RADAR RANGEFINDER WITH 10(EXP -7) RESOLUTION

Y. MIZUSHIMA, M. TAKEICHI, Y. WARASHIMA, A. TAKESHIMA, I. OGAWA, K. ICHIE, and N. H. SCHILLER (Hamamatsu Corp., Bridgewater, NJ.) In NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 437-440 Jul. 1992 Sponsored in part by Hamamatsu Photonics K. K.; Japan Key Technology Center; and Shizuoka Prefectural Government
Avail: CASI HC A01/MF A03

A novel geodetic laser radar rangefinder (GLRR) unit utilizing a pair of synchronized 10-psec streak camera systems was developed for displacement measurements of the earth's plates. In order to achieve minimum computing error and assure extremely high spatial resolution, an optical pulse registration clock was developed and used to register a fiducial mark on the time scale of the system. Conventional optical rangefinders have been limited to a relative resolution of 10(exp -6) even for short distances. The system to be reported on today has the capability of measuring a 50km range with an accuracy of 4mm corresponding to a relative resolution of 10(exp -7). With a gain of greater than $3 \times 10(\text{exp } 3)$, the system has the capability of detecting extremely weak signals on the order of photon counting. This combined with temporal gating makes daytime measurements comparable in signal-to-noise ratio to nighttime viewing. This is useful for measuring faint signals returning over a range of several tens of kilometers. The present ranging system was designed to observe the mutual displacement of geodetic plates and was employed to measure the boundary between the Philippine and Asian geodetic plates that pass beneath the Suruga Bay near Hamamatsu City, Japan. The system has been in operation for over 3 years. In addition, the system has the ability of producing and detecting optical ranging pulses of several wavelengths simultaneously, making this a complete multicolor system. The basic GLRR system consists of a frequency stabilizing crystal, optical clock, YAG laser, KDP doubling crystal, DK*P tripling crystal, two matched streak

cameras (A and B), a control computer, and an output/input periscope system. Author

N92-31058*# Tohoku Univ., Sendai (Japan). Inst. of Technology.

TM,HO:YAG LASER WITH TUNABLE RANGE OF 2.08-2.12 MICRONS AND ITS APPLICATIONS TO SPECTROSCOPY

KAZUHIRO ASAI and TOSHIKAZU ITABE (Ministry of Posts and Telecommunications, Tokyo, Japan) In NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 553-554 Jul. 1992

Avail: CASI HC A01/MF A03

In recent advanced lasers, 2 micron solid-state lasers such as Tm:YAG and Ho:YAG lasers are very attractive for laser radar remote sensing technologies because of eye safety, realizations of all solid-state laser pumped by diode laser and smaller dimension, tunability of lasing wavelength, possibility of coherent detection, etc. Featuring these advantages, 2 micron lasers have been candidates as laser transmitters for use in water vapor Differential Absorption Lidar (DIAL), laser altimeter, Doppler wind sensor, Mie lidar, etc. Characterization of a tunable Cr, Tm, Ho:YAG laser and its applications to spectroscopy concerning absorption and reflectance are reported. Author

N92-33626# National Inst. for Fusion Science, Nagoya (Japan).

SUPERPOSED-LASER ELECTRON ACCELERATION

T. MARUYAMA (Nagaoka Technological Univ., Japan) and S. KAWATA (Nagaoka Technological Univ., Japan) Feb. 1992 21 p Submitted for publication
(ISSN 0915-633X)

(NIFS-133) Avail: CASI HC A03/MF A01

A new mechanism is proposed for electron acceleration by using two superposed laser beams in vacuum. In this mechanism an electron is accelerated by the longitudinal component of the wave electric field in the overlapped region of two laser beams. Single-particle computations and analytical works are performed in order to demonstrate the viability. These results show that the electron can be accelerated well in the proposed mechanism. Author

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MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

A92-10105

A STUDY OF THE RELATIONSHIP BETWEEN FRICTIONAL CHARACTERISTICS AND SURFACE CONDITION OF MECHANICAL FACE SEALS

TAKAO SHIMOMURA, HIROSHI HIRABAYASHI (Eagle Industry Co., Ltd., Okayama, Japan), and TOSHIKATSU NAKAJIMA (Okayama University, Japan) (STLE, Annual Meeting, 45th, Denver, CO, May 7-10, 1990) STLE Tribology Transactions (ISSN 0569-8197), vol. 34, Oct. 1991, p. 513-520. refs
Copyright

This paper deals with the sealing characteristics of mechanical face seals from the viewpoint of rubbing surface conditions. The relationship between topography of the sealing surface of the mechanical face seal and the frictional, wear and sealing characteristics were experimentally evaluated. As a result of testing, it became clear that the radius of curvature of the asperity in profiles of roughness curve of the mating ring surface on the mechanical face seal has a remarkable effect on the friction and wear characteristics of mechanical face seals. Author

A92-11119

KINEMATICS OF ADAPTIVE TRUSS PERMITTING NODAL OFFSET (CONFIGURATION AND WORKSPACE REACH)

MASAO TANAKA, YASUYUKI SEGUCHI, and KAZUYUKI HANAHARA (Osaka University, Toyonaka, Japan) (Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990) *Journal of Intelligent Material Systems and Structures* (ISSN 1045-389X), vol. 2, July 1991, p. 301-327. refs
Copyright

The adaptive truss structure of statically determinate topology has a capability to perform the required task and to meet the environment by adapting its geometrical configuration and mechanical properties. This article discusses the configuration and workspace reach of the practical model of the geometry adaptive truss of helical mast. At the preliminary stage, the kinematics of the ideal truss model is described. Then, the practical structure is investigated for the adaptive truss permitting the offsets at the truss nodes. The kinematics are formulated in the context of incremental analysis. The procedures to analyze the configuration and workspace reach are described in the context of the incremental kinematics. Some illustrative case studies are also conducted. Author

A92-11891

ANISOTROPY OF FRICTIONAL FORCES IN MUSCOVITE MICA
MOTOHISA HIRANO, REIZO KANEKO (NTT, Interdisciplinary Research Laboratories, Musashino, Japan), KAZUMASA SHINJO (ATR Optical and Radio Communications Laboratories, Kyoto, Japan), and YOSHITADA MURATA (Tokyo, University, Japan) *Physical Review Letters* (ISSN 0031-9007), vol. 67, Nov. 4, 1991, p. 2642-2645. refs
Copyright

The static and dynamic frictional forces of single-crystal muscovite mica are measured as a function of the lattice misfit angle between the two contacting cleavage lattices at a very light load under both dry and ambient atmospheres. The frictional forces are anisotropic with respect to the lattice misfit angle, i.e., they increase (decrease) when the contacting surfaces approach being commensurate (incommensurate). The underlying mechanisms of the anisotropy are discussed in terms of the commensurability between the contacting lattices. Author

A92-13139

DESIGN OF SUPPORT STRAP WITH ADVANCED COMPOSITE MATERIALS

T. HIROKAWA, Y. IWASAKI, J. YASUDA (Shikishima Canvas Co., Ltd., Shiga, Japan), S. NISHIJIMA, and T. OKADA (Osaka University, Ibaraki, Japan) IN: *Advances in cryogenic engineering - Materials*. Vol. 36, pt. B. New York, Plenum Press, 1990, p. 1019-1026. Research supported by Osaka University and Shikishima Canvas Co., Ltd. refs
Copyright

A strap design aimed at the practical application of the advanced support system is presented. The straight area was made of unidirectionally reinforced composites and the grip area was fabricated by 3DFRP to remove the stress concentration. It was found that stress concentrations play an important role in the advanced composite materials because the fracture toughness of the materials is small compared with the GFRP although the mechanical strength is greater. P.D.

A92-13669

PENETRATION OF HYPERVELOCITY PROJECTILES INTO ALUMINUM AND POLYETHYLENE THIN-SHEET STACKS

AKIKO NAKAMURA, KEN-ICHI YAGUCHI, AKIRA FUJIWARA, TOSHIIHIKO KADONO, and KOHJI SUGIYAMA (Kyoto University, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2129-2133. refs
Copyright

Experiments on the penetration of nylon spheres of a nominal velocity of 3.6 km/s into aluminum and polyethylene sheet stacks are described. The penetration depth, the diameter of the holes produced on the sheets along the track, and the mass of the recovered projectile fragments were determined as a function of sheet thickness and spacing. It is concluded that the multi-sheet

stack system approaches a uniformly distributed material when the spacing and the thickness of the sheets are small enough in comparison with the size of the projectile. O.G.

A92-15364

NOISE AND VIBRATION CHARACTERISTICS OF A 3 KW-CLASS STIRLING ENGINE

NOBORU KAGAWA (National Defense Academy, Yokosuka, Japan) *JSME International Journal, Series II* (ISSN 0914-8817), vol. 34, Nov. 1991, p. 575-582. refs
Copyright

A92-15581

FABRICATION AND TESTING OF CERAMIC TURBINE WHEELS

K. TAKATORI, T. HONMA, N. KAMIYA, H. MASAKI, S. WADA (Toyota Central Research and Development Laboratories, Inc., Aichi, Japan), and S. SASAKI (Toyota Motor Corp., Shizuoka, Japan) *ASME, International Gas Turbine and Aeroengine Congress and Exposition, 36th, Orlando, FL, June 3-6, 1991*. 7 p. refs
(ASME PAPER 91-GT-142)

Si3N4 radial inflow turbine wheels were fabricated by injection molding. The wheels were 142 mm in outer diameter and had 14 blades. The radial wheel was divided into two pieces for injection molding, and put together into one body by a cold isostatic pressing step after binder removal. Spin testing was executed at room temperature, and the resulting photographs, taken from three directions, provided useful information about the fracture mode of the wheels. The maximum burst speed of the wheels at room temperature was 98,900 rpm, which corresponded to 145 percent of the design speed. In a hot rig test, one of the wheels survived 75,000 rpm for 10 minutes at a turbine inlet temperature of 1,050 C. Author

A92-17412

A SMALL-SIZE ULTRASONIC LINEAR MOTOR

JUNICHI TOYODA and KANJI MURANO (Sony Corp., Tokyo, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2274-2276. refs
Copyright

A new structure for an ultrasonic linear motor using piezoelectric actuators has been developed. The ultrasonic vibrator consists of a metal bar with two legs. The direction of the slider's movement is controlled by changing the polarity of the drive voltage of the multilayered piezoelectric actuator. Typical performance characteristics of the linear motor are a velocity of 1 m/s and a static thrust of 100 gf. Author

A92-17414

ULTRASONIC MOTOR UTILIZING ELASTIC FIN ROTOR

TATSUYA UCHIKI, KENTARO NAKAMURA, MINORU KUROSAWA, SADAYUKI UEHA (Tokyo Institute of Technology, Yokohama, Japan), and TORU NAKAZAWA (ALPS Electric Co., Ltd., Nagaoka, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2289-2291. refs
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The design principles of a 5-mm-diam ultrasonic micromotor utilizing an elastic fin rotor are discussed, and the characteristics of the experimental rotor model of the motor are described. The experimental rotation speed of the rotor model was found to be nearly equal to that of the theoretical. I.S.

A92-17463

MANUFACTURING AND METROLOGY TOOLING FOR THE SOLAR-A SOFT X-RAY TELESCOPE

W. R. SIGMAN, L. V. BURNS, C. G. HULL-ALLEN, A. F. SLOMBA, and R. G. KUSHA (United Technologies Optical Systems, West

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Palm Beach, FL) IN: Advanced optical manufacturing and testing; Proceedings of the Meeting, San Diego, CA, July 9-11, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 386-400. refs
Copyright

Design of the Solar-A Soft X-Ray telescope that will be flown aboard the Japanese Solar-A Satellite is considered with particular attention given to structural analyses of specialized tooling. The telescope has survived a full amplitude vibration test of the flight article and performed well during testing at X-ray wavelength. The fidelity of finite element codes is found to be excellent at the submicron level after the removal of large rigid body terms. Fabrication of high precision grazing incidence telescopes is within the current state of the art. Aluminum tooling is capable of overcoming the limitation of the CTE mismatch and meeting the precision requirements for optical fabrication. O.G.

A92-22664

EFFECTS OF ELASTIC MODULI OF CONTACT SURFACES IN ELASTOHYDRODYNAMIC LUBRICATION

M. KANETA, H. NISHIKAWA, K. KAMEISHI, T. SAKAI (Kyushu Institute of Technology, Kitakyushu, Japan), and N. OHNO (Saga University, Japan) ASME, Transactions, Journal of Tribology (ISSN 0742-4787), vol. 114, Jan. 1992, p. 75-80. refs
(Contract MOESC-63460086)

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Using the optical interferometry technique the film profile in circular elastohydrodynamic contacts is examined with several kinds of fluid under wide ranges of loads and speeds. It is found that under a sliding condition a deep conical depression (dimple) occurs in the contact surface in place of the flat plateau predicted by the EHL theory. This dimple phenomena can be explained by the squeeze film effect acting parallel to the contact plane attributable to the difference in surface deflections of the contact bodies. That is, if the contacting bodies are different in their elastic moduli, EHL film shape is markedly influenced by the slide/roll ratio even if the rolling or entrainment velocity is kept constant. This result suggests that the establishment of a new EHL theory, which takes into consideration the effects of the difference in elastic moduli of the contacting surfaces and surface pressure components parallel to the contact tangent plane, is necessary for deeper understanding of the EHL regime. Author

A92-23136

PREPARATION OF FINE SiC PARTICLE REINFORCED AL ALLOY COMPOSITES BY COMPOCASTING PROCESS

KENJI MIWA and TERUO OHASHI (Nagoya Institute of Technology, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 355-362. Research supported by Research Foundation for Materials Science. refs
Copyright

Preparation of fine SiC particle (under 5 microns) reinforced Al alloy matrix composites by a compocasting process is tried. The effects of some factors, such as the addition rate of SiC and preheating of SiC, to get acceptable composites are discussed. In order to get good incorporation, the addition rate of SiC must be decreased with a decrease in the size of SiC. Most of gas absorbed on the surface of SiC prepared in air is H₂O, and it liberates by heating to 600 C. SiC particles incorporate well and disperse as a single particle in the alloy slurry by the preheating treatment at 600 C for 1 hour. Author

A92-23137

ON THE PROPERTIES OF SINTERED AL AND CU COMPOSITES FROM SPHERICAL COMPOSITE POWDER

ICHIRO SHIOTA, YOSHIO IMAI, YOSHIKAZU SHINOHARA, SUSUMU IKENO (National Research Institute for Metals, Tokyo, Japan), and KIMIKO SAKATA (Tokyo, Science University, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite

Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 363-369. refs
Copyright

The structures and room-temperature properties of ceramic powder Al and Cu composites are discussed. Al₂O₃ or Y₂O₃ powder was mixed into Al or Cu powder, and the mixed powder was spheroidized by mechanical shock method. Each spheroidized powder was fabricated into a block by hot-pressing in a vacuum. The block was swaged to make a wire. The reduction of the cross sectional area were 65, 75 and 85 percent. The ceramics network was broken during fabrication of the wire. Elongation of each composite was fairly good. The tensile strength increased and the elongation became small with the reduction. Electric resistivity decreased with the breakdown of the ceramic network. It became a constant value which was very close to the unique specific resistivity of each matrix metal, when the reduction was 75 percent. Author

A92-23672

DEVELOPMENT OF SELF-MOBILE SPACE MANIPULATOR SYSTEM

TETSUJI YOSHIDA and HIROSHI UENO (Shimizu Corp., Tokyo, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 89-92. refs

The development of a self-mobile manipulator system is described. The system includes a five-degree-of-freedom walking robot, a gravity-compensation system to provide a zero-gravity environment for experiments, and corresponding control software for both robot and gravity compensation system. A general description of the development of the system is given, i.e., robot hardware design, flexible robot control, sensing utilization, human/machine interface, and gravity compensation system. The objectives of the mechanical design are sufficient strength with minimum weight, and compact joints with minimum friction and backlash. The walking motion is partitioned into four phases, and different controllers are used for the corresponding motions. Visual and force feedback to operators for teleoperation are described as are command input via master/slave control and a six-degree-of-freedom stylus. A gravity compensation system is developed with a passive counterweight to balance gravitational effects, while an active x-y planar positioner keeps the support point above the robot. Author

A92-26725

THERMAL PLASMA SYNTHESIS OF CERAMIC POWDERS AND COATINGS

TOYONOBU YOSHIDA (Tokyo, University, Japan) IN: Combustion and plasma synthesis of high-temperature materials. New York, VCH Publishers, 1990, p. 328-339. refs
Copyright

This paper characterizes three types of injection-plasma processing (IPP) and reviews the problems relating to IPP. In order to demonstrate the feasibility and prominent features of IPP, special attention is given to radio-frequency (RF) and hybrid-plasma processing, which are discussed in conjunction with recent research concerning the synthesis of ceramic powders and coatings. Super-high-rate deposition of ceramics and RF-plasma spraying of ceramics are proposed as two distinctive candidates for the future development of IPP in the field of ceramic technology. Author

A92-29253

COMPENSABILITY OF END-EFFECTOR POSITION ERRORS FOR FLEXIBLE ROBOT MANIPULATORS

MASARU UCHIYAMA (Tohoku University, Sendai, Japan) and ZHAO H. JIANG (Hiroshima Denki Institute of Technology, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 2. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 1873-1878. refs
(Contract MOESC-607500206; MOESC-62550169)
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A kinematic analysis of the end-effector position errors of flexible robot manipulators is presented. The analysis gives kinematic fundamentals for their trajectory control. The end-effector position errors due to the link flexibility cannot be controlled directly but can be compensated for only indirectly by the joint angles or displacements. The compensation, however, is very difficult if the manipulator arm takes on certain configurations. The analysis of these situations leads to a new concept of compensability that tells if the compensation is possible or not. A theorem and lemmas are derived to clarify the necessary and sufficient conditions of the compensability. A measure of the compensability is presented to evaluate the ease of compensation. It is shown that the manipulability of a flexible robot manipulator is worse than that of a rigid manipulator because of link deflections. I.E.

A92-30991
APPLYING A FLEXIBLE MICROACTUATOR TO ROBOTIC MECHANISMS

KOICHI SUZUMORI, SHOICHI IKURA (Toshiba Corp., Research and Development Center, Kawasaki, Japan), and HIROSHISA TANAKA (Yokohama National University, Japan) (IEEE, International Conference on Robotics and Automation, Sacramento, CA, Apr. 7-12, 1991) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 12, Feb. 1992, p. 21-27. refs
 Copyright

A flexible microactuator (FMA) driven by an electropneumatic (or electrohydraulic) system has been developed. It has three degrees of freedom-pitch, yaw, and stretch-making it suitable for robotic mechanisms such as fingers, arms, or legs. It is made of fiber-reinforced rubber, and the mechanism is very simple, enabling miniature robots without conventional link mechanisms to be designed. Serially connected FMAs act as a miniature robot manipulator. The kinematics and control algorithm for this type of robot are presented. FMAs combined in parallel act as a multifingered robot hand, with each FMA representing a finger. An algorithm for the cooperative control for such FMAs, the stable region for holding, and its performance have been developed. I.E.

A92-32509
PERFORMANCE OF A HIGH-PRESSURE-RATIO CENTRIFUGAL COMPRESSOR INFLUENCED BY DISTRIBUTION OF TIP CLEARANCE OF THE MIXED-FLOW IMPELLER

HIROSHI HAYAMI, YASUTOSHI SENOO, and HIROSHI HASEGAWA Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2652-2657. In Japanese. refs

To investigate influences of the distribution of tip clearance on the performance of centrifugal compressors, the mixed-flow impeller of a centrifugal compressor with 10:1 pressure ratio was tested with various distributions of the tip clearance varied by not only the axial movement but also the radial reforming of the shroud casing relative to the impeller. Measured data on the decrements of the input head and of the impeller efficiency due to the distribution of tip clearance are compared with the predicted values. The change in the available flow range due to the distribution of tip clearance is also discussed. Author

A92-32677
PRODUCTION OF METAL FIBER BY COILED SHEET SLICING METHOD AND ITS COMPOSITE MATERIALS

A. YANAGISAWA, M. KANEKO (Nippon Institute of Technology, Miyashiro, Japan), and T. NAKAGAWA (Tokyo, University, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 17-N-1 to 17-N-10. refs

A new process is described whereby long metal fibers are produced by slicing a coiled thin metallic sheet. The method has been demonstrated in manufacturing trials for brass, copper, and stainless steel. The method is characterized by high productivity and makes it possible to produce uniformly mixed fibers of different

materials (e.g., metals, plastics, and paper) which are wound layer by layer. The properties of the fibers produced by this method are examined in relation to the process variables. Applications to the production of composite materials are discussed. V.L.

A92-35422
INVESTIGATIONS OF TRIBOLOGICAL CHARACTERISTICS OF SOLID LUBRICANTS EXPOSED TO ATOMIC OXYGEN

MASASHI ARITA, YOSHITERU YASUDA, KATSUHIRO KISHI (Nissan Motor Co., Ltd., Yokosuka, Japan), and NOBUO OHMAE (Osaka University, Suita, Japan) (STLE and ASME, Tribology Conference, Saint Louis, MO, Oct. 14-16, 1991) STLE Tribology Transactions (ISSN 0569-8197), vol. 35, no. 2, April 1992, p. 374-380. refs
 Copyright

Four kinds of solid lubricants, sputtered MoS₂ film, inorganic binder-type spray-bonded MoS₂ film, organic binder-type spray-bonded MoS₂ film and ion-plated Pb film, were exposed to an atomic oxygen (AO) beam. The effects of exposure on their lubricating performance were examined in a pin-on-disk sliding test under vacuum conditions. Changes in the degree of oxidation of these films were analyzed by Auger electron spectroscopy. Exposure to the AO beam resulted in significant changes in lubricating performance and surface oxidation. Of the solid-lubricant films tested, sputtered MoS₂ film showed the most resistance to oxidation. The results are of interest to the evaluation of lubricants for spacecraft in LEO orbit. Author

A92-35614
STUDY OF THE LIFETIME OF LUBRICATED CYLINDERS FOR USE IN SPACE

TAKABUMI HIRAOAKA and TOSHIO HONDA (Toshiba Corp., Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 23, 24. In Japanese. refs

Tests on lubricated cylinders in vacuum are presented. The relationship between wear life and the coefficient of friction of a cylinder is illustrated. The metal fatigue of the cylinder after friction is also considered. Y.P.Q.

A92-35615
RESEARCH ON SOLID LUBRICATION UNDER VACUUM CONDITIONS

H. YOSHII and NORITSUGU KAWASHIMA (Toshiba Corp., Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 25, 26. In Japanese. refs

Tests on solid lubrication for the Japanese Experiment Module Remote Manipulator System (JEMRMS) are presented. Test requirements are given and results are analyzed. Y.P.Q.

A92-35616
DEVELOPMENT OF A SOLID LUBRICATION FOR GEARS FOR USE IN SPACE. I

YUKIO MIYAGAWA (Hosei University, Tokyo, Japan), M. NISHIMURA, SEKI KATSUMI (National Aerospace Laboratory, Tokyo, Japan), A. SASAKI, NORITSUGU KAWASHIMA, and TOSHIO HONDA (Toshiba Corp., Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 27, 28. In Japanese. refs

A reliability test on solid lubrication for gears under vacuum is presented. The lubricant performances of different kinds of composite metal capsules are compared. The average coefficients of friction on a gear surface were determined. Y.P.Q.

A92-35618
TEST ON A SMALL PUMP FOR USE IN SPACE

H. OKASAKI, M. MINAMI, I. YAMADA, KIICHIRO MIYAMOTO (Mitsubishi Electric Corp., Tokyo, Japan), and TOMOO NAKANISHI (Kobe Steel, Ltd., Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan

37 MECHANICAL ENGINEERING

Society for Aeronautical and Space Sciences, 1991, p. 31, 32. In Japanese.

The characteristics and structure of a small pump for use in space are presented. The pump configurations are given and functional test results are analyzed. Further thermal cycle and vibration tests are expected. Y.P.Q.

A92-36031

TOTAL ANALYSIS OF OVERALL PERFORMANCE AND AXIAL THRUST OF ROCKET PUMP

JUNICHI KUROKAWA (Yokohama National University, Japan), KENJIRO KAMIJO, and TAKASHI SHIMURA (National Aerospace Laboratory, Kakuda, Japan) IN: Numerical simulations in turbomachinery; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991, p. 29-34. refs
Copyright

The total analysis of the pump performance and axial thrust is developed in order to determine the axial thrust behavior of multistage pumps with complex thrust balancing devices. The analysis depends mainly on the boundary values of the velocity and pressure of the gap flow. The impeller performance prediction and the angular momentum balance presented here provide satisfactory estimates of these values and accurately predict axial thrust behavior. The axial thrust of the LOX pump varies largely with the fixed orifice gap, and the balancing device has significant stiffness against thrust variation. The operating gap, which can be as narrow as 0.1 mm, increases by 1.6 times with installation of a balancing hole; the reliability of the device also increases, while the stiffness decreases significantly. A balancing piston in the LOX pump has high reliability for gap blockage and damage, and the operating gap and pressure distribution change little for large variations of leakage. C.D.

A92-36878

THE TRIBOLOGICAL REACTION ACCOMPANYING FRICTION AND WEAR OF SILICON NITRIDE CONTAINING TITANIUM NITRIDE

Y. IMADA, K. KAMAMURA, F. HONDA, and K. NAKAJIMA (Toyota Technological Institute, Nagoya, Japan) ASME, Transactions, Journal of Tribology (ISSN 0742-4787), vol. 114, no. 2, April 1992, p. 230-235. refs
Copyright

The effects of ambient gas humidity in air or argon are investigated for the sliding contact-instigated tribochemical reaction in Si₃N₄-23 percent TiN-Si₃N₄-23 percent TiN. The experimental results obtained indicate that wear rate decreases with increasing humidity; wear properties are somewhat improved through the addition of TiN to Si₃N₄. Either SiO₂ or TiO₂ is produced on the surface during friction and wear, in quantities that increase with humidity. The amount of NH₃ formed is directly connected with the amount of SiO₂/TiO₂. O.C.

A92-36887

ENTRY FLOW AND PRESSURE JUMP IN SUBMERGED MULTI-PAD BEARINGS AND GROOVED BEARINGS

A. MORI (Kansai University, Suita, Japan), T. MAKINO (NTN Corp., Iwata, Japan), and H. MORI (Setsunan University, Neyagawa, Japan) ASME, Transactions, Journal of Tribology (ISSN 0742-4787), vol. 114, no. 2, April 1992, p. 370-377; Discussion, p. 377, 378. refs
(ASME PAPER 91-TRIB-42) Copyright

Numerical studies are conducted to investigate the flow and pressure fields along the runner surface in submerged multi-pad and/or multi-grooved bearings under high Reynolds number. The cavity region between the pads and/or the oil feed groove is modified into rectangular shape. The bearing gap region is modified into linearly tapered one. The two-dimensional full Navier-Stokes equations are solved consistently for both regions by means of the penalty function formulation and the Galerkin finite element method incorporated with the Newton-Raphson linearization. General feature of the inertia effects on the entry flow and pressure

jump is illustrated under various conditions. The results are used to improve the former simplified approach, which is based on the quasi-fully developed gap flow linked to the cavity flow of boundary layer type by using conservation equations of mass and mechanical energy. Author

A92-36901

UNSTEADY FLOW WITHIN CENTRIFUGAL COMPRESSOR CHANNELS UNDER ROTATING STALL AND SURGE

S. MIZUKI (Hosei University, Tokyo, Japan) and Y. OOSAWA (NTT, Tokyo, Japan) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 114, no. 2, April 1992, p. 312-320. refs
(ASME PAPER 91-GT-85) Copyright

Unsteady flow patterns throughout a centrifugal compressor system during the rotating stall and the surge were measured experimentally. Various kinds of unsteady behavior of the flow appeared both continuously and suddenly as the flow rate decreased. The part-span stall, the full-span stall, the mild and deep stalls, and the deep surge appeared clearly. The fluctuations caused by the full-span stall were seen even during surge and affected the flow within the scroll through the vaneless diffuser. The experimental results were compared with those computed by the lumped parameter theory. Good agreements between them were obtained when appropriate values were selected for the lumped parameters. Author

A92-36907

STUDY OF INTERNAL FLOWS IN A MIXED-FLOW PUMP IMPELLER AT VARIOUS TIP CLEARANCES USING THREE-DIMENSIONAL VISCOUS FLOW COMPUTATIONS

A. GOTO (Ebara Research Co., Ltd., Fujisawa, Japan) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 114, no. 2, April 1992, p. 373-382. refs
(ASME PAPER 90-GT-36) Copyright

The complex three-dimensional flow fields in a mixed-flow pump impeller are investigated by applying the incompressible version of Dawes' Three-Dimensional Navier-Stokes code. The applicability of the code is confirmed by comparison of computations with a variety of experimentally measured jet-wake flow patterns and overall performances at four different tip clearances, including the shrouded case. Based on the computations, the interaction mechanism of secondary flows and the formation of jet-wake flow are discussed. In the case of large tip clearances, the reverse flow caused by tip leakage flow is considered to be the reason for the thickening of the casing boundary layer followed by the deterioration of the whole flow field. Author

A92-36908

THE EFFECT OF TIP LEAKAGE FLOW ON PART-LOAD PERFORMANCE OF A MIXED-FLOW PUMP IMPELLER

A. GOTO (Ebara Research Co., Ltd., Fujisawa, Japan) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 114, no. 2, April 1992, p. 383-391. refs
(ASME PAPER 91-GT-84) Copyright

An experimental investigation is conducted of the flow phenomena around the positive slope region of head flow in a mixed-flow pump impeller, at various tip clearances and for both shrouded and unshrouded cases. The interaction between tip leakage flows and secondary flows, and the formation of the wake regions in shrouded and unshrouded configuration, are characterized on the basis of computations of the Dawes (1988) 3D Navier-Stokes code. Inlet recirculation was triggered by corner separation, and developed more slowly for larger tip clearances. A decreased Euler's head due to the abrupt flow-pattern change caused by inlet recirculation in the unshrouded case is associated with positively sloped head-flow characteristics. O.C.

A92-38216

ROBOTICS APPLICATION IN AEROSPACE MANUFACTURING

MASANORI HIROSE (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya

Chamber of Commerce and Industry, 1990, p. 125-130. In Japanese.

The improvement of robots in terms of reliability and precision is discussed. The application of robots in airframe manufacturing lines including part fabrication, assembly, painting, and inspection is presented. The development of end effectors and CAD/CAM related peripheral software is outlined. Y.P.Q.

A92-38821

SAME PHASE DRIVE-TYPE ULTRASONIC MOTORS USING TWO DEGENERATE BENDING VIBRATION MODES OF A DISK
TAKEHIRO TAKANO (Tohoku Institute of Technology, Sendai, Japan), YOSHIRO TOMIKAWA, and CHI HARU KUSAKABE (Yamagata University, Japan) IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (ISSN 0885-3010), vol. 39, no. 2, March 1992, p. 180-186. Research supported by Akai Foundation and MOESC. refs
Copyright

Same-phase drive-type ultrasonic motors, using two degenerate bending vibration modes of a disk, are presented. The distinctive feature of the motor is in using the standing wave modes. The motor is not driven by two input signals with different phases, but by input signals with the same phase. Therefore, only one amplifier is sufficient to drive the motor. The experimental results have proved that the motor can yield stable operational characteristics at low speed and high torque. I.E.

A92-39271

SHAPE CONTROL EXPERIMENTS WITH A FUNCTIONAL MODEL FOR LARGE OPTICAL REFLECTORS

MASAKI TABATA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan), NOBORU ITOH, KEIZO MIYAWAKI, ATSUSHI SATORI (Mitsubishi Electric Corp., Communication Equipment Works, Amagasaki, Japan), MASANORI IYE, YASUMASA YAMASHITA, TAKESHI NOGUCHI (National Astronomical Observatory, Mitaka, Japan), and WATARU TANAKA (Tokyo, University, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 615-630. refs
Copyright

Quasi-static shape control experiments of an optical reflector were performed to ascertain the capability of active optics system for future large astronomical telescopes. The experimental apparatus consists of a 62 cm-diameter thin spherical mirror, high precision force controlled actuators, optical wavefront aberration sensors, and an elevation angle driver. Using the experimental apparatus, the mirror figure control in range of the visible light wavelength was performed for correction of lower spatial frequency modes. The control algorithm, experimental results and error evaluation are reported in this paper. Through the various experiments, basic performance of the apparatus and the control algorithm are confirmed to be adaptable to the active mirror support system of telescopes in the next generation. Author

A92-39635

FABRICATION OF TiC/Ni FUNCTIONALLY GRADIENT MATERIALS AND THEIR MECHANICAL AND THERMAL PROPERTIES

XIANGFENG MA, KIMI AKI TANIHATA, YOSHINARI MIYAMOTO (Osaka University, Ibaraki, Japan), AKINAGA KUMAKAWA (National Aerospace Laboratory, Kakuda, Japan), SATOSHI NAGATA (Mitsubishi Heavy Industries, Ltd., Aerospace System Works, Nagoya, Japan), TOMOHIKO YAMADA, and TOHRU HIRANO (Daikin Industries, Ltd., Sakai, Japan) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 7-8, July-Aug. 1992, p. 356-364. Research supported by Science and Technology Agency of Japan. refs
Copyright

A TiC/Ni functionally gradient material (FGM) fabricated via gas-pressure combustion sintering is presently investigated to establish its mechanical and thermal properties. Attention is given to the FGM's specific thermal conductivities with different thermal

cycling conditions; these are found to decrease with thermal cycling in all samples tested, implying that the lateral cracks are generated in the FGM and then propagated by the thermal cycle. High compressive stresses are induced at the TiC surface when this is constrained by a Cu block. O.C.

A92-39638

FABRICATION OF TiB₂-Cu BASED FUNCTIONALLY GRADIENT MATERIAL BY SHS PROCESS

NOBUHIRO SATA (Government Industrial Research Institute, Sendai, Japan) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 7-8, July-Aug. 1992, p. 384-391. Research supported by Science and Technology Agency of Japan. refs
Copyright

A series of producing process of a functionally gradient material (FGM) by self-propagating high-temperature synthesis (SHS) process have been developed, and TiB₂-Cu based FGM was fabricated by the process. Using the automatic powder spraying and stacking device, raw material powders were sprayed and stacked on Cu substrate so that the compositional profile can be graded as nonlinear as fitting the material design after synthesis. This stacked body was compressed and vacuum-sealed into the capsule for the synthesis. The FGM sample was ignited and compressed with synthesizing simultaneously under high-hydropressure of 58 MPa. As a result of this process, TiB₂-Cu based FGM of 1 mm thickness and 30 mm diameter can be produced on Cu substrate. Author

A92-39664

FABRICATION OF SiC WHISKER-REINFORCED SiC CERAMICS

KAORU MIYAHARA, TAKASHI WATANABE, SHIN KOGA, and TADASHI SASA (Ishikawajima-Harima Heavy Industries Co., Ltd., Research Institute, Tokyo, Japan) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 9-10, Sept.-Oct. 1992, p. 704-711. Research supported by New Energy and Industrial Technology Development Organization. refs
Copyright

A fabrication process of SiC whisker-reinforced SiC ceramics consisting of whisker CVD-coating for the control of interfacial bonding, slurry-pressing and HIP consolidation has been developed. Microstructural observation confirmed the incorporation of the interfacial carbon layer in the composites brought about remarkable whisker bridging/pull-out in the fracture. Whisker-bridging was considered to be a predominant toughening mechanism. To optimize the interfacial properties, the effect of coating conditions, i.e., amount of coating and CVD temperature, on the fracture toughness were studied. The effect of whisker diameter on the fracture toughness and anisotropy in the fracture toughness were also investigated. Author

A92-42375

DEVELOPMENT OF LARGE HIGH STRENGTH ALUMINUM ALLOY COMPONENT FOR SPACECRAFT

NAOTAKE YOSHIHARA (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan), SEISHI TSUYAMA (NKK Corp., Fukuyama Research Laboratories, Japan), YOSHIMICHI HINO, and KATSUHIKO HIROKAMI (NKK Corp., Kawasaki, Japan) NKK Technical Review (ISSN 0915-0544), no. 64, April 1992, p. 21-27. refs
Copyright

NKK developed and supplied a large aluminum alloy (7075-T7352) spacecraft component. Two major problems could arise in manufacturing this part by conventional production methods: difficulty in achieving the specified strength because of the very thick sections and difficulty in removing the residual stress from quenching because of the complex shape. NKK developed a production method that solved these problems. This paper describes the results of theoretical analysis on the generation and removal of residual stress, experimental studies on the removal of residual stress in small blocks, and full-scale tests to verify the selected method. Author

A92-42884

A PERFORMANCE TEST OF DIAMOND COATED INSERTS USED FOR TURNING A HIGH SI-AL ALLOY

M. MURAKAWA, S. TAKEUCHI, Y. HIROSE (Nippon Institute of Technology, Miyashiro, Japan), K. KOMAKI, and M. YANAGISAWA (Showa Denko, Tokyo, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 815-820. refs
Copyright

A cutting test of diamond coated inserts, to which improved adhesion is imparted through a pretreatment process to the substrate, is presented. Diamond films are deposited through either the thermal filament CVD technique, utilizing ethanol as the precursor or the combustion flame technique conducted in a vacuum chamber, employing acetylene gas as the precursor. After turning tests of Al-18 percent Si alloy were performed for 180 minutes, diamond-coated tools produced by both methods were still found to show no peeling of the coating. R.E.P.

A92-43213

ON THE CHARACTERISTICS OF SERVO ACTUATORS ATTACHED TO A MODEL SPACEPLANE FOR DYNAMIC WIND-TUNNEL TEST

TAKASHI SHIMOMURA, SHUICHI SASA, MASAOKI YANAGIHARA, and MASAHICO NAGAYASU (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990. Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 516-519. refs

This paper describes identification of servo actuators of a model spaceplane. The actuators contain two nonlinear elements which are saturation on an input and backlash on an output. The existence of them makes identification to be difficult, so some ideas are required. An identification method for such a system is proposed, and parameters characterizing the actuators are estimated from experimental data. Author

A92-43234

SUPERPLASTIC FORMING OF AL-LI ALLOYS

TAKAYUKI TSUZUKU and AKIO TAKAHASHI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990. Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 600-603. In Japanese.

Superplastic forming technology for Al-Li alloys is presented. Heat treatment conditions are described, and the resulting strength characteristics are evaluated. Y.P.Q.

A92-44732

SUPER PLASTIC FORMING TECHNOLOGY APPLIED TO AEROENGINE AND SPACE EQUIPMENT

KATSUMI MANDAI Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 2, March 1992, p. 61-65. In Japanese.

Titanium alloys, especially Ti-6Al-4V, are widely used for the aeroengine and space equipment because of their high strength ratio and excellent resistance to heat and corrosion. But this material is difficult to manufacture by conventional plastic forming technology. It has been reported that Ti-6Al-4V shows extensive ductility (superplasticity), more than 1000 percent under the condition of both low straining rate and high temperature ranges. Superplastic forming technology applying this characteristic is widely known as one of the most cost-effective methods to save material. At the plant, gas argon blowing equipment for the superplastic forming technology has been developed and 'V2500 nose fairing' and 'fuel tank of the H-II rocket second stage reaction control system' have been manufactured. This paper describes the superplastic forming equipment and the two products above. Author

A92-44733

BASIC STUDY OF ADHESIVE BONDING FOR FIBER-COMPOSITES - ADHESIVE BONDING TECHNOLOGIES ON JET ENGINE PARTS

TAKAHITO ARAKI and TADAHIRO WASHIZU Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 2, March 1992, p. 66-68. In Japanese. refs

Adhesive bonding technology in jet engine parts has become more important due to recent applications of fiber-composite parts in jet engines. Adhesive bonding to the fiber-composites were studied for some kinds of composites which have a matrix resin such as epoxy, polyimide, and PEEK. Lap shear specimens were made from two types of combined adherends: composite to composite and composite to metal. Lap shear tests were conducted according to the ASTM D-3163 procedures. The lap shear coupons were blasted with Al₂O₃ grit. It appeared that different processes and different adherend combinations evidently changed the strength and the heat resistance strength of bonding. The amorphous bonding technique used a polyether imide (PEI) film that was coconsolidated with the PEEK/CF adherends follow by secondary bonding. Author

A92-44735

DEVELOPMENT OF WALL CLIMBING ROBOT

HISAO KOJIMA, RYOUSEI TOYAMA, and KENGO KOBAYASHI Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 2, March 1992, p. 123-128. In Japanese. refs

A configuration design is presented for a wall-climbing robot with high payload which is capable of moving on diversified surfaces of walls including the wall surface to ceilings in every direction. A developed quadruped wall climbing robot, NINJYA-1, is introduced. NINJYA-1 is composed of legs based on a 3D parallel link mechanism and a VM (Valve-regulated Multiple) sucker which will be able to suck even if there are grooves and a small difference in level. A wall climbing robot which supports rescue operation at a high building using a VM sucker is also introduced. Finally, a wall climbing robot named Disk Rover with a disk-type magnetic wheel is shown. The wheel shape is calculated by FEM. The disk-type magnetic wheel has a force three times more powerful than the one heretofore in use. Author

A92-45260

STUDY OF GRINDING PROCESS AND STRENGTH FOR CERAMIC HEAT INSULATED ENGINE

HIDEO KAWAMURA (Isuzu Ceramics Research Institute Co., Ltd., Fujisawa, Japan) Society of Manufacturing Engineers, Superabrasives'91 Conference, Chicago, IL, June 11-13, 1991. 19 p. refs

(SME PAPER MR91-177) Copyright

Steps are described for the successful development of a ceramic thermally insulated turbine engine. The strength of the ceramic engine parts can be effectively increased depending on the grinding methods used. Because many microcracks have been observed after the grinding of engine parts with low strength, grinding processes are, therefore, studied. Since wear resistance, abrasion resistance, and low friction are the principal factors required of reciprocating engines, machining precision of these engines' sliding parts largely affects their abrasion and friction properties. Structural analysis means are discussed to estimate the mechanical and thermal stresses acting on all the ceramic components. Experimental results are discussed with regard to the workability of two types of Si₃N₄. It is shown that as machining efficiency improves, the affected layer increases for baking both at atmospheric pressure and at high pressure. Comparisons of strength properties are made for the Si₃N₄ materials under both baking conditions. S.A.V.

A92-45400

SMALL PARTICLE ACCELERATION BY MINI-RAILGUN

YOSHINOBU HOSHI and HIRO YOSHIDA (MITI, Mechanical Engineering Laboratory, Tsukuba, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium,

29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 303-308. refs (SAE PAPER 911998) Copyright

A new particle accelerator is described which consists of the combination of a high-pressure gas gun and a small railgun. Two gas pressure acceleration models are described and their predictions are compared with experimental data. It is shown how the acceleration mechanism of the minirailgun differs from a conventional one in taking plasma gas pressure into account.

C.D.

A92-46721

CONTROLLABLE SQUEEZE FILM DAMPER (AN APPLICATION OF ELECTRO-RHEOLOGICAL FLUID)

SHIN MORISHITA (Yokohama National University, Japan) and JUNICHI MITSUI (Tonen Corp., Saitama, Japan) ASME, Transactions, Journal of Vibration and Acoustics (ISSN 0739-3717), vol. 114, no. 3, July 1992, p. 354-357. refs

Copyright

A notable characteristic of electro-rheological (ER) fluid is the variation of its apparent viscosity with the application of an electric field. The application of this characteristic to the performance of squeeze film damper of a flexible rotor is investigated in this paper. It is shown experimentally that by controlling the supporting damping capacity continuously, rotor vibration can be reduced remarkably a wide range of rotating speed. Moreover, the study indicates experimentally that there exists an optimum supporting damping for every vibration mode.

Author

A92-47402

THEORETICAL ANALYSIS OF INTERFERENCE OF TEETH IN STRAIN WAVE GEARING

TAKESHI ISHIDA, TERUAKI HIDAKA, and SHUIPING HUANG Yamaguchi University, Faculty of Engineering, Memoirs (ISSN 0372-7661), vol. 42, no. 2, March 1992, p. 19-25. In Japanese. refs

This paper deals with a theoretical analysis of the interference in a strain wave gearing (commonly known as a harmonic drive), which is a compact, light-weight mechanical device capable of high speed reduction as well as high mechanical advantage in a single stage. The analysis is carried out in a plane perpendicular to the input and output axes, and in a no-load state. The involute profiles of teeth are simplified to straight lines. When the flexible spline is deformed into an oval shape by the wave generator, it is assumed that a neutral line exists there, which maintains the same length as that prior to deformation. The number of teeth causing interference at the same time in a strain wave gearing is found by the analysis, which changes with a period of one pitch of the circular spline.

Author

A92-50199

A NEW TYPE OF SUPERCONDUCTING JOURNAL BEARING USING HIGH TC SUPERCONDUCTORS

M. KOMORI and T. KITAMURA (Kyushu Institute of Technology, Iizuka, Japan) Cryogenics (ISSN 0011-2275), vol. 32, no. 7, 1992, p. 628-633. refs

Copyright

The characteristics between a set of alternating-polarity ring magnets and a superconductor are studied. The magnets have strong repulsion and attraction forces with the superconductor owing to the pinning effect. Using these characteristics a prototype of a superconducting journal bearing with a magnet shaft supported by a cylindrical housing has been developed. The superconductors (type-II superconductors) and a magnet shaft as the rotor of alternating-polarity ring magnets of the same size. The magnet shaft can be levitated in the center of the housing without contact. Levitation and drag forces of the superconducting journal bearing are investigated. The levitation force shows circular hysteresis loops depending on the displacement because of the flux pinning effect. Owing to the simple and useful structure of the superconducting journal bearing it is applicable to practical devices in the industrial field.

Author

A92-50777

DESIGN AND DEVELOPMENT OF A MINIATURE STIRLING MACHINE

N. KAGAWA (National Academy, Yokosuka, Japan), K. ARAOKA (Toshiba Corp., Research and Development Center, Kawasaki, Japan), and T. OTAKA (Toshiba Corp., Yokohama, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 5. La Grange Park, IL, American Nuclear Society, 1991, p. 192-197. refs

Copyright

For the purpose of examining the applicability of a Stirling engine thermodynamic and mechanical analysis, a 3 kW class two-piston engine, NS03T, and a small size displacer engine, SD01 were examined with respect to the operation of the cooling mode. The 1987 NS03T engine obtained a cooling capacity of 700 W at 1.5 MPa charged helium pressure and 1000 rpm piston speed with 112 K temperature difference. The 1989 SD01 engine produced 18 W expansion work at 0.25 MPa charge helium pressure and 1100 rpm with 23 K temperature difference. The behavior of the calculated results for each engine specification produces that of the experimental data with reasonable accuracy. The cylindrical cam mechanism of the SD01 engine was modified in order to construct the attractive Stirling cooling machine. I.E.

A92-50785

REDUCTION OF TORQUE PULSATION OF STIRLING ENGINE-COMPRESSOR SYSTEM

TOSHIHIDE KODA, MICHIO FUJIWARA, and TAKUYA SUGANAMI (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 5. La Grange Park, IL, American Nuclear Society, 1991, p. 251-255. Research sponsored by MITI. refs

Copyright

The refrigerant compressor driven by a Stirling engine is built into the heat pump system. The Stirling engine-compressor unit generates rolling vibration due to a fluctuation in combined torque. In order to reduce the rolling vibration, the torque characteristics and the linkage construction of the crankshafts are investigated. The investigation was undertaken for the beta-displacer-type and the two-piston-type configurations. In addition to the Stirling engine, a four-stroke internal combustion engine was considered as a reference. When the Stirling engine drives the compressor, the vibration characteristics depend on its linkage construction. The combined torque which caused the rolling vibration was calculated on the Stirling engine-compressor unit. I.E.

A92-50790

EFFECTS OF REGENERATOR SIZE CHANGE ON STIRLING ENGINE PERFORMANCE

K. HAMAGUCHI (Hokkaido Polytechnic College, Otaru, Japan), Y. HIRATSUKA (Daikin Industries, Ltd., Sakai, Japan), and H. MIYABE (Meiji University, Kawasaki, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 5. La Grange Park, IL, American Nuclear Society, 1991, p. 293-298. refs

Copyright

A systematic approach to the regenerator shape design is developed. The basic data reported with respect to the flow loss and heat transfer characteristics of the stacked wire gauzes, which have often been used as a regenerator matrix, are put in order by using the fixed dimensionless parameters. The effect of the regenerator shape on the engine performance is studied theoretically and experimentally. In the theoretical study, an equivalent indicated thermal efficiency is defined and the effects of size change are investigated by using a simple analysis. The effects of regenerator shape are experimentally evaluated by the engine performance. I.E.

A92-50803

R&D ON SMALL SOLAR STIRLING ENGINES TNT-2 AND 3, NAS-1

37 MECHANICAL ENGINEERING

NAOTSUGU ISSHIKI, HIROICHI WATANABE (Nihon University, Koriyama, Japan), KORO SHISHIDO (Tohoku Gakuin University, Tagajo, Japan), and KUNIYA WATANABE (Tohoku Electric Power Co., Inc., Sendai, Japan). IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 5. La Grange Park, IL, American Nuclear Society, 1991, p. 382-387. refs
Copyright

A unique 1-kW solar Stirling engine, the TNT-1, 2, and 3, is tested utilizing the internal solar heating method. Two solar concentrator dishes are tested for a prototype for future large solar Stirling power plant systems. These Stirling engines have transparent cylinder heads at their top made of quartz glass, and the solar beam concentrated by the solar dishes heats up directly the inside meshes installed upon the displacer piston, penetrating through the quartz glass. An atmosphere hot air Stirling engine NAS-1 is under test, which has rubber diaphragm power piston and quite simple construction. I.E.

A92-52040

THEORETICAL STUDY ON THE THERMAL CONTACT RESISTANCE OF A SPACE-USE DEEP GROOVE BALL BEARING

KATSUHIKO NAKAJIMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 462, 1992, p. 376-383. In Japanese. refs

The thermal contact resistance between the balls and the inner and outer rings of a space-use deep groove ball bearing is analyzed assuming that heat transfer between smooth contacting elements occurs through the elastic contact areas. It is also assumed that the stationary bearing sustains axial and/or radial loads under steady-state temperature condition. The shapes and sizes of the contact areas are calculated using the Hertzian theory. The thermal analysis is based on an isolated isothermal elliptic contact area supplying heat to an insulated half-space. The formulation of the resistance is given as a function of a geometric factor of the contact area and the thermal conductivity of the bearing. In particular, an expression for the axial load is derived with careful consideration of changes in contact angle induced by elastic deformation at the contact area. Author

A92-53510

EVALUATION OF SOLID-LUBRICATED BALL-SCREW IN A VACUUM

MASATOSHI CHIBA, TORU GYOJI (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan), MAKOTO NISHIMURA, and KATSUMI SEKI (National Aerospace Laboratory, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 439-443.

Copyright

Ball screws lubricated by solid lubricants are a key component for large space constructions with linearly moving parts. This paper reports a study aimed at understanding lubricating performance and lifetime of ball screws lubricated by solid lubricant films continuing molybdenum disulfide under a simulated space environment. It is found that ball screws made of bearing steel SUS 440C and 6Al-4V-titanium have a wear life of more than 10 million revolutions. C.D.

A92-54938

DOUBLE PISTON SHOCK-WAVE VALVE

H. ONODERA (Iwate University, Morioka, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, no. 10, Oct. 1992, p. 2569-2571. refs

Copyright

A new concept for a shock-wave valve is introduced. The valve has a simple structure, is easy to operate, is suitable for large-scale shock tubes, and generates very little turbulence in the flowfield produced. C.D.

A92-55409

PRODUCTION OF FLEXIBLE METAL MATRIX COMPOSITES REINFORCED WITH CONTINUOUS SI-TI-C-O FIBERS BY ATMOSPHERIC PLASMA SPRAYING

Y. WAKU, N. NAKAGAWA, Y. OHSORA, T. TAKAHASHI, K. SHIMIZU, T. YAMAMURA (Ube Industries, Ltd., Inorganic Research Laboratory, Japan), and A. OHMORI (Osaka University, Japan) Journal of Thermal Spray Technology (ISSN 1059-9630), vol. 1, no. 2, June 1992, p. 171-178. refs
Copyright

An experiment is conducted to fabricate a flexible prepreg sheet with a continuous Si-Ti-C-O fiber by means of an air-plasma spraying method for use as an MMC plate. Plasma spraying is conducted under atmospheric conditions, and the prepreg and MMC sheets are investigated by means of a three-point flexural test and Auger electron spectroscopy to study strength and oxidation qualities. The oxidation layer is found to be about 200 Å in depth, and the longitudinal and transverse flexural strengths of a unidirectionally reinforced MMC plate fabricated by hot pressing at 660°C are given as 1.0 and 0.25 GPa, respectively. The technique outlined is shown to be useful for developing squeeze-cast MMCs reinforced with Si-Ti-C-O that have high specific strength, specific modulus, and heat resistance. C.C.S.

A92-56098

MANUFACTURING DEVELOPMENTS OF FILAMENT WINDING FOR THERMOPLASTIC COMPOSITES

MINORU KIMURA, HARUYOSHI SAIGOKU, KIYOSHI TSUCHIYA (Fuji Heavy Industries, Ltd., Tokyo, Japan), and TAKASHI ISHIKAWA (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 444-447. In Japanese. refs

Thermoplastic composite materials for aerospace structures are examined. A forming method for filament windings is described, and the hot pressing technology is discussed. The test results are given, and the nondestructive inspection of fracture surfaces is considered. Y.P.Q.

A92-56106

AUTOMATED FINISHING FOR MACHINED PARTS

TOMOHIKO MIYABE (Japan Aircraft Development Corp., Tokyo) and HITOSHI FUKAGAWA (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 478-481. In Japanese. refs

An automatic finishing system for machined parts was constructed and its efficiency was evaluated. The use of a six-axis robot combined with a force sensor and some equipment resulted in enough quality to remove burr and mismatch without handworking. C.D.

A92-56107

DEVELOPMENT OF AN AUTOMATIC DRILLING SYSTEM. II

JUNICHI ITO and YUJI SHINAGAWA (SMIC, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 482-485. In Japanese.

An automatic drilling system used in the assembly of aircraft structures is presented. The configurations of the automatic drilling equipment are described. Y.P.Q.

A92-56108

PRACTICE OF SUPERPLASTIC FORMING APPLIED ON AL ALLOY SHEET

NOBUYUKI SUZUKI, WATARU ASAI, KIYOSHI WATANABE (NIPPI, Japan), and WIKIO SASAZIMA (Japan Aircraft Development Corp., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 486-489. In Japanese. refs

A program of gas pressure for superplastic forming was determined by the equation of simplified deformation that simulated the intended shape according to the forming time. The die used

at high temperatures was made from thermoceramics by casting. This program and die were used to form the air-intake lip of airplane which has complex curved surfaces. As a result, the efficacy of the pressure programming method and the utility of ceramics die were verified. Author

A92-56109

APPLICATION OF AUTOMATION FOR STRUCTURAL-COMPOSITES PRODUCTION

TAKAHISA HASEGAWA and HIROYUKI ANDO (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 490-493. In Japanese. refs

An outboard aileron has been developed using composite materials. The production automation and tool structure are described. C.D.

N92-13430# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.

WATER-COOLING TECHNIQUE OF HIGH TEMPERATURE GAS TURBINE BLADE

TOSHIO SAKUMA May 1989 35 p In JAPANESE; ENGLISH summary (DE90-503403; CRIE-T-88056) Avail: CASI (US Sales Only) HC A03

The experimental results of water cooled turbine blades which were performed under non-steady state conditions are described, and the flow resistance is obtained experimentally. The essential results are as follows: (1) temperate fluctuation of blade and cooling water can be restrained using a concentric tube of cooling holes; (2) cooling effectiveness of the blade is nearly constant independent of cooling water flow rate; and (3) friction loss of rotating concentric tube and loss of heat in the region of 180 degree turnover, at rotation, are obtained. DOE

N92-13432# Central Research Inst. of Electric Power Industry, Tokyo (Japan).

DEVELOPMENT OF GAS TURBINE COMBUSTOR BURNING COAL DERIVED LOW BTU GASEOUS FUELS, PART 4

M. SATO, T. NINOMIYA, T. NAKADA, T. ABE, HIROSHI ISHIKAWA, T. YOSHINE, M. YAMADA, S. HISA, and H. HASEGAWA Oct. 1989 25 p In JAPANESE; ENGLISH summary (DE90-507871; CRIE-W-89014-PT-4) Avail: CASI (US Sales Only) HC A03/MF A01

This paper describes the development of a gas turbine combustor burning coal-derived low calorific value gaseous fuels. Combustion tests were conducted using a combustor of a 150 MW class gas turbine. Coal derived gaseous fuels contain carbon monoxide and hydrogen as main combustible components, but also contain more than 60 percent of nitrogen, carbon dioxide etc., and their calorific values are approximately one-tenth of natural gas. Rich-lean combustion was very effective for decreasing fuel nitrogen oxides emission in a gas turbine combustor. However, the flame stability must be maintained in a primary combustion zone, and a sub combustor was provided for the flame stability. The combustibility of the tested combustor was excellent. Methane concentration in coal derived gaseous fuels affected on fuel nitrogen oxides formation, and it was clarified that there will be optimum equivalence ratio in a primary combustion zone according with the change of methane concentration. DOE

N92-14348*# Kyushu Electric Power Co., Inc., Fukuoka (Japan). Thermal Power Dept.

FIELD TELEMETRY OF BLADE-ROTOR COUPLED TORSIONAL VIBRATION AT MATUURA POWER STATION

NUMBER 1 UNIT

KUNIYOSHI ISII (Kyushu Electric Power Co., Inc., Fukuoka (Japan)), HIDEAKI MURAKAMI (Kyushu Electric Power Co., Inc., Fukuoka (Japan)), YASUHIKO OTAWARA (Hitachi Ltd. (Japan)), and AKIRA OKABE (Hitachi Ltd., Japan) In NASA. Lewis Research Center, Rotordynamic Instability Problems in

High-Performance Turbomachinery, 1990 p 15-20 Oct. 1991 Avail: CASI HC A02/MF A04

The quasi-modal reduction technique and finite element model (FEM) were used to construct an analytical model for the blade-rotor coupled torsional vibration of a steam turbine generator of the Matuura Power Station. A single rotor test was executed in order to evaluate umbrella vibration characteristics. Based on the single rotor test results and the quasi-modal procedure, the total rotor system was analyzed to predict coupled torsional frequencies. Finally, field measurement of the vibration of the last stage buckets was made, which confirmed that the double synchronous resonance was 124.2 Hz, meaning that the machine can be safely operated. The measured eigen values are very close to the predicted value. The single rotor test and this analytical procedure thus proved to be a valid technique to estimate coupled torsional vibration. Author

N92-14361*# Kobe Univ. (Japan). Faculty of Engineering.

EXPERIMENT OF STATIC AND DYNAMIC CHARACTERISTICS OF SPIRAL GROOVED SEALS

T. IWATSUBO, B. C. SHENG, and M. ONO In NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 p 223-233 Oct. 1991 Avail: CASI HC A03/MF A04

The leakages and the dynamic characteristics of six types of spiral grooved seals are experimentally investigated. The effect of the helix angle of the seal is investigated mainly under the condition of the same nominal clearances, land and groove lengths, and groove depths. The dynamic characteristics are measured for various parameters such as preswirl velocity, pressure difference between inlet and outlet of the seal, whirling amplitude, whirling speed, and rotating speed of the rotor. The results are also compared with leakage increases with the increase of the helix angle, but as the rotating speed increases, the leakages of the larger helix angle seals quickly drop. The leakage of the smooth-stator (SS)/smooth-grooved rotor (SGR) seal drops faster than that of the spiral-grooved stator (SGS)/smooth-rotor (SR) seal. It is found that a circumferential flow can be produced by the flow along the helix angle direction, and this circumferential flow acts as a negative swirl. For the present helix angle range, there is an optimum helix angle with which the seal has a comparatively positive effect on the rotor stability. Compared with the SGS/SR seals, the SS/SGR seal has a worse effect on the rotor stability. Author

N92-15388# Japan Atomic Energy Research Inst., Tokyo.

NUMERICAL SIMULATION OF BIPED LOCOMOTION ROBOT

ETSUO KUME (Japan Atomic Energy Research Inst., Tokai.) Mar. 1991 89 p In JAPANESE; ENGLISH summary (DE91-508090; JAERI-M-91-047) Avail: CASI HC A05/MF A01

The Human Acts Simulation Program (HASP) has been performed since 1987 at JAERI. In this program, a human-shaped robot reads and understands instructions written in natural languages such as Japanese, planning and producing a required sequence of actions, approach to a device or an instrument recognizing its entity and does the ordered work for plant maintenance. All of these processes are simulated by logical and numerical computations. The major aim of the HASP is to develop fundamental technologies for the design of intelligent robots. This report will describe the simulation methods and results of a human-shaped robot motions. The simulation methods of the robot's arms and robot's start and stop motions have been newly developed based on the steady walking model with fixed arms developed by M. Vukobratovic. The influence of arm motions to the stable walking and the continuous connection from start to steady walking, etc. will be discussed. DOE

N92-23779# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

SLIDING FRICTION TEST OF SELF LUBRICATING POLYMER COMPOSITES FOR ROLLING BEARING RETAINER [KUFU KORO GARI JIKUKE HOJIKI YO JIKOJUNKATSUSEI KOBUNSHI FU KUGOZAI NO SUBERI MASATSU SHIKEN]

37 MECHANICAL ENGINEERING

MAKOTO NISHIMURA Jun. 1990 17 p In JAPANESE
(ISSN 0452-2982)

(NAL-TM-622; JTN-92-80310) Avail: CASI HC A03/MF A01

Most drive mechanisms onboard artificial satellites are equipped with solid lubricating rolling bearings which use both solid lubricating films and self lubricative composite retainers. In the United States, a combination of PTFE (Poly Tetra FluoroEthylene) polymer composites and molybdenum disulfide sputtered film predominate as rolling bearing materials for aerospace uses. In this paper, sliding friction characteristics of solid lubricative films, such as films of gold, silver, lead, PTFE and molybdenum disulfide were studied. It was proved that lubricative characteristics of molybdenum disulfide sputtered film exhibited the best performance in vacuum. Next, various rolling bearings made from PTFE films, molybdenum disulfide sputtered films and polymer composites were tested. It was shown that a combination of molybdenum disulfide sputtered films and PTFE composites gave the performance of low friction and long life, and had a life of over 10,000 hr at operational speeds of 2,000 rpm. Author (NASDA)

N92-25101# New Energy Development Organization, Tokyo (Japan).

SURVEY ON THE ENERGY TRANSPORTATION TECHNOLOGY FOR THE ALTERNATIVE ENERGIES

Mar. 1991 299 p In JAPANESE; ENGLISH summary

(DE92-769382; NEDO-P-9006) Avail: CASI HC A13/MF A03

A system is studied in which hydrogen is produced through a water electrolysis process using clean energy from hydro-electric and solar power generators which can be obtained overseas with relative ease and at a low cost and is converted to a transportable chemical medium for transportation to Japan and utilization as energy like electricity, etc. The hydroelectric power generation is the most realistic alternative energy source in terms of energy density, technology and economy. The feasibility is described the development of hydroelectric power generation using rivers in Indonesia and Canada. As chemical substances which can be transportable chemical media, methanol/CO cycle (methanol is synthesized from coal gasified CO and electrolytic hydrogen) or liquid hydrogen cycle are the most practical on a short-term basis, and ammonia cycle and cyclohexane cycle are more advantageous than other cycles on a long-term basis. It is essential to reduce a cost of water electrolysis for each chemical substance. Potential needs are great for distribution and utilization of hydrogen energy regenerated from the transportable chemical medium, but it requires a lot of technological innovations regarding the system structure and materials (safety, particularly). DOE

N92-25342# National Aerospace Lab., Tokyo (Japan).

TURBINE DRIVE SYSTEM OF THE HIGH PRESSURE LOX TURBOPUMP TEST FACILITY

Y. WATANABE, S. HASEGAWA, K. KAMIJO, R. HASHIMOTO, Y. SAKAMOTO, and S. TONE Jan. 1991 17 p In JAPANESE; ENGLISH summary

(DE92-783191; NAL-TM-631) Avail: CASI HC A03/MF A01

This paper describes the turbine drive system of facilities such as a gas generator among high pressure liquid oxygen (LOX) turbopump test facilities, which were constructed for the rating test of a high pressure LOX turbopump. In particular, the control sequence of the high pressure gaseous hydrogen/liquid oxygen gas generator and the turbine exhaust gas disposal unit for high pressures and large flows are explained in detail. The gas generator requires a large amount of propellant. Therefore control valves or remote control valves, which can accurately control and supply large and small amounts of propellant, are needed. As a result, a programmable sequencer was developed in order to control the opening and closing of every valve. Moreover, as a solution to the problem of aerodynamic noise and oscillation, a method to install a pressure reducing unit in the exhaust gas disposal system was applied. As a result, it was possible to discharge a large quantity of high temperature and high pressure combustion gas with excess hydrogen after driving the turbine without excessive noise and oscillation. DOE

N92-27431# National Aerospace Lab., Kakuda (Japan). Research Center.

AN EXPERIMENTAL STUDY OF A SMALL HIGH SPEED LH2 ROCKET PUMP: A SUPPRESSION METHOD OF

ASYNCHRONOUS SHAFT VIBRATIONS Report No. 1

MITSUO WATANABE, MAKOTO YOSHIDA, SATOSHI HASEGAWA, and KENJIROU KAMIJOU Jul. 1991 16 p In JAPANESE; ENGLISH summary

(ISSN 0389-4010)

(NAL-TR-1118; JTN-92-80385) Avail: CASI HC A03/MF A01

Liquid Hydrogen (LH2) rocket pumps must be operated at high speed due to the low density of LH2, with this requirement being even greater for upper stage rocket engine and Orbiter Transfer Vehicle (OTV) pumps. In these operating conditions, the suppression of shaft vibration is one of the most complex design problems since the damping effect is very small due to the extremely low LH2 viscosity. Many shaft vibration problems have occurred during the development of actual pumps, e.g., the Liquid Rocket Engine-5 (LE-5) and Space Shuttle Main Engine (SSME) LH2 pumps. This paper describes a new pump configuration which was developed using a mechanical design method that allows the operational speed to be lower than the critical speed. The new pump operated smoothly at its designed rotational speed of 50,000 rpm and was within permissible shaft vibration limits. This method was subsequently applied to the design of the LE-7 high pressure liquid oxygen pump. Author (NASDA)

N92-27432# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

ANTENNA POINTING SYSTEM MOUNTED ON A FLEXIBLE SPACE STRUCTURE

ISAO YAMAGUCHI, TAKASHI KIDA, SEIYA UENO, and MASAKI TANAKA Aug. 1991 33 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1119; JTN-92-80386) Avail: CASI HC A03/MF A01

The enhancement of structural damping for suppression of vibrations caused by dynamic interactions of an antenna pointing system mounted on a flexible space structure is examined, and groundbased experimental results performed to demonstrate its efficiency are discussed. Damping augmentation is achieved using a type of Proof Mass Actuator (PMA) driven by a control law based on Direct Velocity FeedBack (DVFB). Experiments show that this actuator successfully stabilizes the structure which is otherwise destabilized by the antenna pointing system. It is additionally found that the antenna pointing system occasionally displays a nonlinear limit cycle caused by the friction torque. A numerical model is developed to analyze these phenomena and a computer simulation is performed. All experimental results show good agreement with the analysis. Author (NASDA)

N92-27737*# Koyo Seiko Co. Ltd., Kokubuhiganjo (Japan). **CHARACTERIZATION OF SUPERCONDUCTING MAGNETIC BEARINGS (DYNAMIC STIFFNESS AND DAMPING COEFFICIENT IN AXIAL DIRECTION)**

RYOICHI TAKAHATA (Koyo Seiko Co. Ltd., Kokubuhiganjo (Japan).), HIROCHIKA UEYAMA (Koyo Seiko Co. Ltd., Kokubuhiganjo (Japan).), and TSUTOM YOTSUYA (Osaka Prefectural Industrial Technology Research Inst., Enokojima Japan) In NASA. Langley Research Center, International Symposium on Magnetic Suspension Technology, Part 1 p 289-296 May 1992

Avail: CASI HC A02/MF A04

High T(sub c) superconductor as a stator and permanent magnets for a rotor were assembled into a superconducting magnetic bearing. The dynamic stiffness and the damping coefficient of the superconducting magnetic bearing in axial direction were measured. The dynamic stiffness depended on an axial gap between superconductor and permanent magnet. The superconducting magnetic bearings are advantageous for a passive bearing, because they have a vibration damping effect that a permanent magnet bearing does not have. The tendency of its vibration damping coefficient indicated an increase as the resonant frequency increased. Author

N92-28233# Japan Atomic Energy Research Inst., Tokyo.
A SURVEY REPORT FOR THE DESIGN OF BIPED LOCOMOTION ROBOT: THE WL-12 (WASEDA LEG-12)
 ATSUGO TAKANISHI, ICHIRO KATO (Waseda Univ., Tokyo, Japan), and ETSUGO KUME Nov. 1991 47 p In JAPANESE; ENGLISH summary
 (DE92-782046; JAERI-M-91-197) Avail: CASI HC A03/MF A01

A mechanical design study of biped locomotion robots is going on at JAERI within the scope of the Human Acts Simulation Program (HASP). The design study at JAERI is of an arbitrarily mobile robot for inspection of nuclear facilities. A survey has been performed for collecting useful information from already existing biped locomotion robots. This is a survey report of the biped locomotion robot: the WL-12 designed and developed at Waseda University. This report includes the mechanical model and control system designs. DOE

N92-33783# Mitsubishi Heavy Industries Ltd., Tokyo (Japan).
REVIEW ON LUNAR SURFACE OPERATION ROBOTS [GETSUMEN SAGYOU ROBOTTO NO KENTOU]
 MICHIAKI MIZUOCHI In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE
 Avail: CASI HC A03/MF A10

A review is given of robots to conduct construction of lunar surface sites, to layout each subsystem, and to support lunar surface experiments performed as the first step to set up a concept of lunar bases. The robots' mission requirements and the system review baselines were studied based on the following premises for their missions: (1) to support manned lunar surface sites construction; (2) to transport, install, and connect piping and wiring heavy goods being laid out in inhabited module or drive self-propelled items; (3) to be used only during day time; and (4) to be used from the initial stage of construction of manned lunar surface sites. The results of the review were presented, and the requirements, the baselines for their review, system structure and composition, main features, electric system chart, and development plans of lunar surface robots are shown. Technical problems to be solved such as stereoscopic image processing and seven degree of freedom control technology for manipulators are presented. Observation equipment to be operated by the robots on the lunar surface are: (1) radio, visible and infrared, and x-ray telescopes; (2) environment monitoring equipment; (3) lunar seismometer; and (4) thermal flow meter. Author (NASDA)

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QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

A92-13570
A NEURAL NETWORK APPLIED TO CRACK TYPE RECOGNITION

T. OGI, M. NOTAKE, Y. YABE (Mitsubishi Research Institute, Tokyo, Japan), and M. KITAHARA (Tokai University, Shimizu, Japan) IN: Review of progress in quantitative nondestructive evaluation. Vol. 9A. New York, Plenum Press, 1990, p. 689-696. refs
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A quantitative nondestructive evaluation system is developed from which the analytical solutions are extracted by means of artificial intelligence. A waveform obtained from the analytical solutions provides quantitative data regarding crack parameters, and a neural network is applied as one of two inference functions in the system. The utility of the neural network is demonstrated with a prototype that concerns the problems of a main crack with a subcrack near the tip. C.C.S.

A92-23113
ON USE OF ELECTRICAL CONDUCTIVITY FOR DETECTING FLAWS AND DELAMINATIONS IN CFRP COMPOSITE LAMINATES

KAZUMASA MORIYA (National Defense Academy, Yokosuka, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 133-140. refs
 Copyright

The probabilistic nature of the electrical conductivity in the transverse direction and the utilization of the transverse conductivity to the monitoring of the onset and growth of damage in CFRP composites are briefly described. The application to the double-cantilever-beam test shows that a small increment of delamination growth can be detected with only a fraction of current that is required for metals. The method is applied to the tensile test of a straight-sided coupon specimen in combination with the acoustic emission technique. The results from the electrical potential measurement are well correlated with the AE data. The vertex of the potential-versus-load plot corresponds to the sudden increase of the AE-event rate which is indicative of the onset of delamination. The present method can be used to detect damage and to provide quantitative information on the integrity of CFRP composite structures. Author

A92-28561
THE DOMAIN BIE APPLIED TO FLAW TYPE RECOGNITION

SOHICHI HIROSE (Okayama University, Tsushima, Japan) and MICHIOHITO KITAHARA (Tokai University, Shimizu, Japan) IN: Review of progress in quantitative nondestructive evaluation; Proceedings of the 17th Annual Review, La Jolla, CA, July 15-20, 1990. Vol. 10A. New York, Plenum Press, 1991, p. 75-82. Research supported by NSF and Japan Society for the Promotion of Science. refs
 Copyright

The aim of the present paper is to show numerical results which may be used as a knowledge base for flaw-type recognition. Some three-dimensional scattering problems of an elastic wave are solved by using a time-domain Boundary Integral Equation (BIE) method. Three types of flaws, a cavity, an inclusion and a crack, are considered. Scattered far-fields by these flaws are calculated as a function of time and are compared to each other to draw some characteristics for flaw type classification. Author

A92-28570
PRELIMINARY STUDY ON ULTRASONIC WAVE SIMULATION IN QUANTITATIVE NON DESTRUCTIVE EVALUATION

SANAE MIYAZAKI (NTT Data Communications Systems Corp., Kawasaki, Japan) and CHITOSHI MIKI (Tokyo Institute of Technology, Japan) IN: Review of progress in quantitative nondestructive evaluation; Proceedings of the 17th Annual Review, La Jolla, CA, July 15-20, 1990. Vol. 10A. New York, Plenum Press, 1991, p. 153-160. refs
 Copyright

An application of ultrasonic testing is examined. In the currently used ultrasonic testing, the size, shape and location of defects are determined by the echo intensity and response time of reflected waves. For quantitative evaluation, however, the scattered wave caused by a defect can be utilized which carries information regarding the defects. This paper examines the reflection and scattering properties of ultrasonic waves in a steel plate with a crack and a cavity as a reflecting source by using numerical simulation and computer graphics. Author

A92-28612
DEPTH DETERMINATION OF SURFACE-BREAKING CRACKS BY A NEURAL NETWORK

M. KITAHARA (Tokai University, Shimizu, Japan), J. D. ACHENBACH, Q. C. GUO, M. PETERSON (Northwestern University, Evanston, IL), T. OGI, and M. NOTAKE (Mitsubishi Research Institute, Tokyo, Japan) IN: Review of progress in quantitative nondestructive evaluation; Proceedings of the 17th

38 QUALITY ASSURANCE AND RELIABILITY

Annual Review, La Jolla, CA, July 15-20, 1990. Vol. 10A. New York, Plenum Press, 1991, p. 689-696.

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A neural network is used to determine the depth of surface-breaking cracks in plates. The cracks are insonified from the opposite plate face using 45-degree transverse waves. The backscattered ultrasonic signal is employed for neural network training and recognition. A three-layered perceptron type network is utilized, and the learning mechanism is the back-propagation algorithm for error correction. The network is trained by using results from a theoretical and numerical analysis which is based on an application of the boundary-element method. The boundary-element calculations are verified using experimental results. Wave scattering data in both the time and frequency domain are used in the network for crack characterization. The performance of the network is discussed for an input of experimental data.

Author

A92-28699

ACOUSTIC EMISSION WAVEFORM ANALYSIS IN COMPOSITES

MANABU ENOKI and TERUO KISHI (Tokyo, University, Japan) IN: Review of progress in quantitative nondestructive evaluation; Proceedings of the 17th Annual Review, La Jolla, CA, July 15-20, 1990. Vol. 10B. New York, Plenum Press, 1991, p. 1499-1506. refs

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An attempt is made to identify the microfracture mechanisms by utilizing AE radiation pattern that is a far-field displacement of AE waveform. Quantitative parameters of microcracking such as mode and size in monolithic materials are evaluated by utilizing the advanced AE measuring system with six channels and analysis system. It is concluded that the waveform groups correspond to cracking of fiber, debonding at interface, friction between specimen and fixture, and cracking of matrix, respectively.

R.E.P.

A92-29666

NDT OF CLOSED CRACKS BY ULTRASONIC PROPAGATION ALONG THE CRACK SURFACE

M. SAKA (Tohoku University, Sendai, Japan) and Y. FUKUDA (NKK Corp., Electronics Research Center, Kawasaki, Japan) NDT & E International (ISSN 0963-8695), vol. 24, Aug. 1991, p. 191-194. refs

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The effect of a fatigue crack on the time of flight of an ultrasonic longitudinal wave propagating along the crack surface is examined in conjunction with nondestructive evaluation of the depth of closed cracks. The characteristic behavior of the time of flight with increasing crack depth has been analyzed experimentally in comparison with measurements for artificial notches.

Author

A92-32758

FACTOR ANALYSIS OF RELIABILITY ON MECHANICAL PROPERTIES OF CFRP

ZENICHIRO MAEKAWA, HIROYUKI HAMADA, ATSUSHI YOKOYAMA, and KUEI-CHI LEE (Kyoto Institute of Technology, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 26-N-1 to 26-N-10. refs

The behaviors of interlaminar and intralaminar cracks propagating in the fiber direction in a CFRP laminate are investigated using results of mechanical fracture tests. It was found that toughening the matrix resin results in increases in the interlaminar and intralaminar toughnesses and can increase the mechanical strength of the laminate. However, the degree of improvement depends on the nature of the fiber and of the matrix resin.

I.S.

A92-32821

FAILURE MODES AND AE CHARACTERISTICS OF CARBON FABRIC COMPOSITES

FENG SUN, ISAO KIMPARA, KAZURO KAGEYAMA, TOSHIO SUZUKI, and ISAMU OHSAWA (Tokyo, University, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 31-C-1 to 31-C-10. refs

Static tensile failure behaviors and AE (acoustic emission) characteristics of non-notched and hole-notched carbon fabric composites was discussed in the present paper. Failure patterns of these composites were observed and then related to the AE parameters. The experimental results show that the arrangements and locations of failures were dependent on weave structures. It was concluded that the initiation and propagation of different failure modes could be evaluated by AE parameters and the behaviors of micro-failure modes of notched specimens were affected by stress concentration and hole size.

Author

A92-32888

NONDESTRUCTIVE EVALUATION OF COMPOSITES BY ELASTIC WAVE PROPAGATION ANALYSIS

TSUYOSHI OZAKI, MITSUHIRO OKUMURA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Sagami-hara, Japan), ISAO KIMPARA, and TOSHIO SUZUKI (Tokyo, University, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 39-D-1 to 39-D-10. refs

A novel system for evaluating defects in composites by analyzing elastic wave propagation in composites is proposed. In this system, a longitudinal wave is introduced into the specimen by a probe which is especially made for FRP. The measured wave signals are Fourier transformed into frequency spectrum data, and evaluation parameters are calculated. Two types of model defects in unidirectional CFRP are detected, namely, the concentrated type, i.e., one hole is located in the middle of the specimen, and the dispersed type, i.e., some holes are dispersed around the specimen. The size and type of these defects are successfully evaluated by the parameter. Dynamic simulations on elastic wave propagation in composites are also carried out; they show the reflection, refraction, and mode transition of elastic waves in detail. The evaluations of defects in composites are successfully simulated on each type of specimen.

P.D.

A92-39850

ACOUSTIC EMISSION SOURCE CHARACTERIZATION

TERUO KISHI and MANABU ENOKI (Tokyo, University, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 217-234. refs

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AE source characterization is developed to understand the dynamic process of microfracture in ceramics, metals and composites. The theoretical background of AE source characterization is investigated for an infinitesimal deformation in a material that is represented as a moment tensor by the 'eigenstrain method' of micromechanics. The analysis system was applied to fracture toughness tests in various materials, and the fracture process of these materials is considered from these obtained source characteristics.

R.E.P.

A92-39851

ELECTRIC POTENTIAL CT METHOD FOR MEASURING TWO- AND THREE-DIMENSIONAL CRACKS

SHIRO KUBO (Osaka University, Suita, Japan), TAKAHIDE SAKAGAMI (Osaka University, Toyonaka, Japan), and KIYOTSUGU OHJI (Osaka University, Suita, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 235-254. refs

Copyright

By applying the concept of inverse analysis, the electric potential computed tomography (CT) technique for measuring 2D and 3D cracks is presented. Based on the boundary element formulation, two inverse analysis schemes, i.e., the inverse boundary-integral

equation technique and the least-residual technique, are developed for the determination of cracks from data of the electric potential observed on the surfaces of cracked bodies. It is shown by experiments and numerical simulations that the proposed method is useful for determining the size, shape and location of 2D and 3D cracks. R.E.P.

A92-43126

BAYESIAN RELIABILITY ANALYSIS IN CONNECTION WITH THE EVALUATION OF MULTIPLE-SITE DAMAGE

HIROSHI ITAGAKI (Yokohama National University, Japan), H. ASADA, and S. ITO (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 152-155. In Japanese. refs

A rivet splice model for analyzing multiple-site damage is presented. The effectiveness of the periodic inspection of multiple-site fatigue cracks along a rivet joint is discussed. The relative frequency distribution of visible crack length and joint posterior probability density are described. Y.P.Q.

A92-43152

INSPECTING THE DAMAGE OF A COMPOSITE MATERIAL STRUCTURE FOR QUALITY ASSURANCE

M. UCHIYAMA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 268-271. In Japanese.

The types of damage of aircraft composite materials are classified. Nondestructive test methods including X-ray detection and ultrasonic detection are discussed. Y.P.Q.

A92-43154

INSPECTION OF COMPOSITE MATERIALS WITH AN ADVANCED ULTRASONIC FLAW DETECTOR

W. YAMAMOTO (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 276-279. In Japanese.

The structures and shapes of the composite material products are described. Methods of ultrasonic wave detection are described. New damage detection equipment for laminate and honeycomb structures is addressed. Y.P.Q.

A92-43156

QUALITY MANAGEMENT OF LANDING GEAR WITH PULLING SUPPORT SYSTEM

M. NIKAI (Japan Air System, Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 284-287. In Japanese.

The maintenance of aircraft landing gear is discussed. Systems for the quality management are given and the pulling support system is emphasized. The quality inspection and landing gear overhaul operation is outlined. Y.P.Q.

A92-46102

FIXED-TIME LIFE TESTS BASED ON FUZZY LIFE CHARACTERISTICS

AKIHIRO KANAGAWA and HIROSHI OHTA (Osaka Prefecture, University, Sakai, Japan) IEEE Transactions on Reliability (ISSN 0018-9529), vol. 41, no. 2, June 1992, p. 317-320. refs (Contract MOESC-63550106)

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This paper deals with a reliability demonstration test with type-I censoring and presents a formulation based on fuzzy-set theory. Acceptable and rejectable MTBFs are represented in terms of a fuzzy concept, and Bayes' theorem plays an important role in the formulation. The proposed life test is useful when it is difficult to specify acceptable and rejectable MTBFs strictly. Author

A92-53479

ULTRASONIC INSPECTION IMPROVEMENT USING FFT FOR H-II SRB LINER-PROPELLANT SEPARATION

TAKAO MANIWA, AKIYOSHI SATO, SATORU HIRANO (Nissan Motor Co., Ltd., Tokyo, Japan), YUKIO FUKUSHIMA, TAKESHI FUJITA, TOMIHISA NAKAMURA (NASDA, Tokyo, Japan), MORIO SHIMIZU, and KATSUYA ITO (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 209-214. refs Copyright

It is experimentally shown that resonance can be easily detected in separation models of H-II upper stage motors using swept frequency ultrasonic detectors and low-peak characterized probes. Favorable results are also reported from experiments applicable to H-II SRB, which has a thicker motor case and liner. C.D.

A92-55797

NEW RELIABILITY ASSURANCE METHOD EFFECTIVE FOR ECONOMICAL SATELLITE ON-BOARD EQUIPMENT

HIROSHI SAKAMOTO and MASAYOSHI TANAKA (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 7 p. refs

(IAF PAPER 92-0420) Copyright

A new reliability assurance method of implementing generally used parts (GUPs) in terrestrial radio equipment for satellite on-board equipment is described. The failure rates of GUPs used in terrestrial radio equipment are investigated. Specifically selected GUPs whose structure was not qualified previously are subjected to several qualification tests, such as shock, vibration, and radiation. A transponder-level burn-in test is carried out in order to confirm that there are no latent defects in the parts. The new method has been applied to the fixed mobile multibeam communications on-board equipment in Japan's ETS-VI program. Many GUPs, up to about 70 percent of all parts, were implemented. A transponder-level burn-in test was carried out for over 3500 hr. No failure parts were found. The present method is expected to reduce the cost of satellite on-board equipment and to promote satellite communications. P.D.

A92-56084

APPLICATION OF X-RAY IMAGE RADIOGRAPHY SYSTEM FOR AIRCRAFT

KENJI TSUBAKI (Kawasaki Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 374-377. In Japanese.

Water entrapment in a honeycomb assembly is generally detected by means of X-ray film method in the maintenance phase. Nowadays, much improvement and lower cost of digital image processing systems accelerates wide use of them in NDI. The Kawasaki Image Radiography Inspection System (K-IRIS) consists of digital image processor, digital controlled X-ray equipment, and a 10-axis teaching playback mechanism. K-IRIS shows its remarkable ability to detect water entrapment and to reduce much inspection time compared with the ordinary film method. Author

A92-56219

TOTAL-DOSE HARDNESS ASSURANCE-TESTING FOR CMOS DEVICES IN SPACE ENVIRONMENT

HIROSHI KAMIMURA, MASAHARU SAKAGAMI, SHUNSUKE UCHIDA (Hitachi, Ltd., Energy Research Laboratory, Japan), and MASATAKA KATO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan) IN: Annual Reliability and Maintainability Symposium, Las Vegas, NV, Jan. 21-23, 1992, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1992, p. 202-209. refs

Copyright

A practical method for total-dose hardness assurance testing for CMOS devices in a space environment is presented to predict the radiation-induced threshold voltage shift and leakage current. Simple radiation response models for the threshold voltage shift and leakage current are given. The model parameters can be determined by laboratory irradiation testing with Co-60 gamma-rays at a high dose rate. Using this method, the threshold voltage shift

39 STRUCTURAL MECHANICS

and leakage current of MOSFETs can be predicted at low dose rate and at any temperature from room temperature to 80 C.

I.E.

39

STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

A92-10182

STRENGTH ESTIMATION OF METAL-FRP BONDED JOINTS AND ITS APPLICATION TO A FILAMENT WOUND PRODUCT
TAKAO MORI, YOSHIHIRO HIRASE, TOSHIO ISHIHARA, MASANORI KAWAHARA, AKIHIKO KATOH (NKK Corp., Advanced Technology Research Center, Kawasaki, Japan), QIANG YU, and MASAKI SHIRTORI (Yokohama National University, Japan) IN: International SAMPE Symposium and Exhibition, 36th, San Diego, CA, Apr. 15-18, 1991, Proceedings. Book 1. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 806-817. refs

Copyright

A stress analysis system for estimating stress in metal-FRP bonded joints was developed by combining FEM code with a preprocessor and a postprocessor. Numerical and experimental analyses were conducted on single lap joints and T-type joints for two combinations of adherends, Al-CFRP and Al-GFRP, and at different temperatures. It is shown that the strength of bonded joints can be well estimated by value of the maximum equivalent stresses, at which the fraction in the joint occurs. This critical stress depends only on the combination of adherends and is independent from the joint type. The analyses were applied to the design of metal-FRP bonded joints in a filament wound cryostat.

I.S.

A92-10336

CRITICAL IMPERFECTION OF SYMMETRIC STRUCTURES
KAZUO MUROTA (Tokyo, University, Japan) and KIYOHITO IKEDA (Nagaoka University of Technology, Japan) SIAM Journal on Applied Mathematics (ISSN 0036-1399), vol. 51, Oct. 1991, p. 1222-1254. refs

Copyright

A method is presented to determine the critical (most unfavorable) initial imperfection of structures of regular-polygonal symmetry (denoted by dihedral groups). A critical point of such structures is either simple or forced to be double by the symmetry, and the group representation theory is employed to deal with the degeneracy due to symmetry. The method is developed further to incorporate the symmetry of imperfections. In many cases of practical interest, the critical imperfection is given explicitly as the product of 'imperfection sensitivity' matrix' and the critical eigenvector. It is shown that the symmetry in the critical eigenvectors of the tangent-stiffness matrix is inherited to the symmetry in the critical imperfection mode.

Author

A92-10542

EFFECT OF SPECIMEN SIZE ON CREEP CRACK GROWTH RATE USING ULTRA-LARGE CT SPECIMENS FOR 1CR-MO-V STEEL
MASAAKI TABUCHI, KIYOSHI KUBO, and KOICHI YAGI (National Research Institute for Metals, Tokyo, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 2, 1991, p. 311-321. refs

Copyright

In order to establish an evaluation method of creep crack growth in the structural components of a high-temperature engineering plant, it is necessary to clarify the effect of specimen size on creep crack growth behavior. Creep crack growth tests were carried out using CT specimens of various sizes, including ultra-large CT

specimens of 254 mm in width and 63.5 mm in thickness. Creep crack growth rate was characterized in terms of C^* parameter. Correlation of creep crack growth rate with C^* parameter was independent of specimen width, but dependent on specimen thickness. As the specimen thickness increased, the creep crack growth rate increased. It was considered that the effect of specimen thickness on creep crack growth rate was due to constraints of deformation during creep crack propagation.

Author

A92-10548

STRAIN ENERGY RELEASE RATE FOR AN INTERFACE CRACK IN LINEARIZED COUPLE-STRESS THEORY

S. ITOU (Kanagawa University, Yokohama, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 2, 1991, p. 421-432. refs

Copyright

In this paper, the effect of couple-stresses on the strain energy release rate for an interface crack is examined. An internal pressure is applied on surfaces of the crack situated between two dissimilar half-planes. The oscillatory stress singularities and material overlappings usually appear near the crack tips in the so-called exact solutions. To avoid these irregularities the crack surface displacements and the crack surface rotation are expanded in series of trigonometrical functions. A modified version of the Schmidt method is then used to determine those coefficients in the series. Numerical calculations are carried out to reveal the effect of the couple-stresses on the strain energy release rate for the interface crack.

Author

A92-11121

IDENTIFICATION AND ADAPTIVE CONTROL OF FLEXIBLE TRUSS STRUCTURES

KOJI SEKINE, YUZO SHIBAYAMA, NAOTOSHI IWASAWA, NORIO TAGAWA (NEC Corp., Space Development Div., Yokohama, Japan), SEI-ICHI SUNAHARA, SHIRO YOSHIDA, and TAKEO ARIKABE (Sumitomo Heavy Industries, Ltd., Aerospace Engineering Dept., Yokosuka, Japan) (Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990) Journal of Intelligent Material Systems and Structures (ISSN 1045-389X), vol. 2, July 1991, p. 347-385. refs

Copyright

This paper describes investigations on adaptive vibration control and shape adjustment of truss structures making use of the active member actuator. The actuator was manufactured in an attempt to achieve these functions by linear actuating. Fundamental characteristics were examined statically and dynamically. Numerical simulations of planar truss model with the configuration of one pair of collocated actuator and sensor shows that a state observer can estimate truncated modes well and the excited vibration can be controlled rapidly.

Author

A92-11280* Virginia Univ., Charlottesville.

NONLINEAR RESPONSE OF RESIN MATRIX LAMINATES USING ENDOCHRONIC THEORY

S. R. MATHISON (Honda Motor Co., Ltd., Tokyo, Japan), M. J. PINDER, and C. T. HERAKOVICH (Virginia, University, Charlottesville) ASME, Transactions, Journal of Engineering Materials and Technology (ISSN 0094-4289), vol. 113, Oct. 1991, p. 449-455. refs

(Contract NAG1-343)

Copyright

The nonlinear response of laminated, resin matrix fibrous composites is modeled using orthotropic endochronic theory. The theory is formulated in terms of elastic constants and endochronic parameters characterizing the linear and nonlinear response, respectively, of unidirectional composites. All constants and parameters can be determined from normal (tension and/or compression) and shear tests on unidirectional and off-axis specimens. The nonlinear constitutive response relations for the unidirectional lamina are presented and the procedure for determining constants and parameters from test is described. The results are then used to predict the nonlinear response of unidirectional laminae and angle-ply laminates. Comparison

between theory and experiment for compression loading of AS4/3502 graphite-epoxy, angle-ply laminates shows excellent correlation. Author

A92-11792
STRENGTH OPTIMIZATION OF LAMINATED COMPOSITES WITH RESPECT TO LAYER THICKNESS AND/OR LAYER ORIENTATION ANGLE

H. FUKUNAGA (National Aerospace Laboratory, Mitaka, Japan) and G. N. VANDERPLAATS (VMA Engineering, Goleta, CA) Computers and Structures (ISSN 0045-7949), vol. 40, no. 6, 1991, p. 1429-1439. refs
 Copyright

This paper deals with the strength optimization problem of laminated composites under in-plane loading based upon the mathematical programming method. Design variables are the layer orientation angles as well as the layer thicknesses. New treatment of design variables with respect to the layer orientation angles is presented. A technique is also proposed to delete the strength constraints of almost zero thickness layers. This new treatment gives an efficient optimization approach of laminated composites. Author

A92-11854
FORMULATION OF THE ANALYTICAL METHOD OF THREE-DIMENSIONAL THERMOELASTIC PROBLEMS IN FINITE DEFORMATIONS

HIDEO IMAI and SUSUMU TAKAHASHI (Kanto Gakuin University, Yokohama, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 34, Oct. 1991, p. 404-411. refs
 Copyright

The conventional consideration of an analytical method in linear thermoelastic problems is applied to nonlinear thermoelastic problems in the second-order theory. The basic equations of nonlinear thermoelastic problems are formulated by using Adkins perturbation method. Thermoelastic potentials applying the Helmholtz theorem are also introduced for analyzing nonlinear thermoelasticity problems. Moreover, by applying these thermoelastic potentials, a formulation of the analytical method is proposed to solve boundary-value problems of axisymmetrical uncoupled quasi-static thermoelasticity in finite deformations. Finally, some potentials for axisymmetrical thermoelastic problems of finite deformations are shown. Author

A92-11855
METHOD OF NUMERICAL ANALYSIS OF THE SINGULAR INTEGRAL EQUATIONS FOR CRACK ANALYSIS

KOJI FUJIMOTO (Tokyo University of Agriculture and Technology, Koganei, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 34, Oct. 1991, p. 430-435. refs
 Copyright

The method of numerical analysis of the singular integral equations for crack analysis by using the method of continuously distributed dislocations model is presented. This method is based on the concept of the boundary collocation and reduces singular integral equations into linear algebraic equations. The presented method made it possible to obtain the solution of the singular integral equations in symmetrical or asymmetrical problems including two or more unknown functions. The accuracy of stress intensity factors obtained by this method was verified by comparing these values with the exact solutions or the reliable numerical solutions obtained by the other researchers. Author

A92-11858
FREE VIBRATION OF A CANTILEVER RECTANGULAR PLATE WITH VARYING THICKNESS

KATSUAKI TANAKA, GEN YAMADA, and YUKINORI KOBAYASHI (Hokkaido University, Faculty of Engineering, Bulletin (ISSN 0385-602X), no. 157, Oct. 1991, p. 47-57. In Japanese. refs

An analysis was presented for the free vibration of a cantilever rectangular plate with varying thickness by using the Ritz method. The transverse deflection of the plate was expressed approximately

in series of the power function. Substituting the expression for the maximum kinetic and strain energies of the plate into Lagrange functional, the frequency equation was derived by the condition for a stationary value of the Lagrange functional. Eigenvalues and mode shapes of vibration were calculated numerically up to higher modes and the effects of the varying thickness on them were studied. Author

A92-12026
SINGULAR BEHAVIOUR AT THE END OF A CRACK YIELDING ON INCLINED SLIP-PLANES

M. TOYA, K. KIRIOKA (Kagoshima University, Japan), and C. YATOMI (Kyoto University, Japan) International Journal of Fracture (ISSN 0376-9429), vol. 50, Aug. 1, 1991, p. 183-198. refs
 Copyright

Based on the Williams (1952) method of the eigenfunction expansions, the singular stress distribution near a mode I crack tip yielding on two inclined slip-planes is obtained in the form with an undetermined constant. It is found that stresses have the singularity of the form $r \exp(\lambda-1)$, where r is the distance from the crack tip, and the exponent $(\lambda-1)$ lies between -0.5 and 0, depending on the inclination angle of the slip-planes. The undetermined constant is then estimated by combining the result with an approximate solution obtained by Rice (1974). The case of a mode III crack is also analyzed, and the results are compared with a known closed-form solution and discussed. Author

A92-12607
DYNAMICS OF CLOSED LINKED VARIABLE GEOMETRY TRUSS MANIPULATORS

HIROSHI FURUYA (Nagoya University, Japan) and KENICHI HIGASHIYAMA (All Nippon Airways, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs
 (IAF PAPER 91-291) Copyright

This paper presents dynamical characteristics of a variable geometry truss manipulator system which consists of a two-dimensional statically determinate truss or space applications. A formulation takes into account geometrical effects of closed-link constraints, variable length mechanisms, rotational degrees of freedom at the joints, and internal control forces developed by Kane's dynamical equations. The conventional formulas of tree-like truss structures are extended to the procedure, which is adapted to statically determine truss structures using a Jacobian matrix derived by geometric considerations. Inverse kinetics of the variable geometry truss have been formulated considering the minimum norm solution to the equations of motion. A two-dimensional variable geometry truss manipulator is simulated numerically as an example of activities on Space Station. Results show the effects of internal control forces on the attitude of the manipulator system in space environment, and the characteristics of the inverse kinetics of the manipulator are investigated. Author

A92-14512
ANALYSIS OF FOLDED PLATE STRUCTURES BY A COMBINED BOUNDARY ELEMENT-TRANSFER MATRIX METHOD

M. OHGA, S. KOHIGASHI (Ehime University, Matsuyama, Japan), and T. SHIGEMATSU (Tokuyama Technical College, Japan) Computers and Structures (ISSN 0045-7949), vol. 41, no. 4, 1991, p. 739-744. refs
 Copyright

A structural analysis method based on a combined use of the boundary element and transfer matrix methods is proposed for static problems of folded plate structures. A transfer matrix is, in this paper, evaluated by assembling of those for in-plane and plate bending problems, which are derived from the systems of equations based on the ordinary boundary element method for in-plane and plate bending problems, respectively. This method, therefore, permits the use of a large number of elements, without getting involved with large matrices. Some numerical examples of plates and folded plate structures subjected to various loads are

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proposed and their results are compared with those obtained by the finite element method. Author

A92-14518

GEOMETRICAL NONLINEAR ANALYSIS OF RECTANGULAR MINDLIN PLATES

H. MATSUDA, C. MORITA, and T. SAKIYAMA (Nagasaki, University, Japan) Computers and Structures (ISSN 0045-7949), vol. 41, no. 4, 1991, p. 869-874. refs
Copyright

An approximate method is developed to study the geometrical nonlinear analysis of the rectangular plates. The solutions are obtained by transforming the partial differential equations into the integral equations and applying the numerical integrations. The nonlinear problem is solved by the iteration and the load incremental procedure. The results are compared with FE-solutions. Author

A92-15329

NON-DIMENSIONAL DESIGN PARAMETERS FOR FOD TOLERANT FAN BLADES

T. SHIOYA (Tokyo, University, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 113-120. refs
Copyright

Nondimensional design concept for foreign-object-damage (FOD) tolerant fan blades is introduced based on the analyses of simplified impact models. The fan blades are idealized as either beams or plates of elastic or rigid-plastic materials. The case of constant force impact as well as that of mass impact is analyzed. The centrifugal force effects are also considered in the beam models. The critical fracture conditions are shown in simple nondimensional formulas or diagrams for each case. Author

A92-16024

A BOUNDARY INTEGRAL EQUATION METHOD FOR AN INVERSE PROBLEM RELATED TO CRACK DETECTION

N. NISHIMURA and S. KOBAYASHI (Kyoto University, Japan) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 32, Nov. 1991, p. 1371-1387. refs
Copyright

This paper discusses an application of a boundary integral equation method to an inverse problem of determining the shape and the location of cracks by boundary measurements. Given that a body contains an interior crack, the shape and the location of which are unknown, on the exterior boundary of this body measurements are performed which are interpreted mathematically as prescribing Dirichlet data and measuring the corresponding Neumann data, or vice versa, for a field governed by Laplace's equation. The inverse problem considered attempts to determine the geometry of the crack from these experimental data. It is proposed to solve this problem by minimizing the error of a certain boundary integral equation. The process of this minimization, however, is shown to require solutions of certain hypersingular integral equations. Hence, regularization methods suitable for solving these integral equations are proposed. Several 2D and 3D numerical examples are given in order to test the performance of the present method. Author

A92-18376

STRESS ANALYSES OF LAMINATED THICK-WALLED CYLINDRICAL ANISOTROPIC SHELLS

O-IL BYON (Nihon University, Narashino, Japan) and JACK R. VINSON (Delaware, University, Newark) AIAA Journal (ISSN 0001-1452), vol. 29, Dec. 1991, p. 2192-2196. Previously cited in issue 11, p. 1695, Accession no. A90-29295. refs
Copyright

A92-18636

SOME CRITICAL QUESTIONS AND FUTURE DIRECTIONS FOR FRACTURE RESEARCH

TAKEO YOKOBORI (Teikyo University, Utsunomiya, Japan) (International Conference on Advanced Materials Mechanical

Properties '90 /ICAMP '90/, Utsunomiya, Japan, Aug. 6-9, 1990, Selected Papers. A92-18634 05-23) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 40, no. 4-5, 1991, p. 705-720. Research supported by MOESC. refs
Copyright

The present article discusses the critical issues and questions and also the future direction in mechanical properties of advanced materials research. Initially, it is emphasized how different fracture science and engineering are from mainly deductive philosophy, such as elasticity or physics, etc. Then, some schools of fracture research are discussed and in the light of the argument, various critical issues and questions are presented. Furthermore, in the present paper, some concepts for overcoming these difficulties are described for the critical problems. Author

A92-19676

FATIGUE 90; PROCEEDINGS OF THE 4TH INTERNATIONAL CONFERENCE ON FATIGUE AND FATIGUE THRESHOLDS, HONOLULU, HI, JULY 15-20, 1990. VOLS. 1-4

HIDEO KITAGAWA, ED. (Nihon University, Tokyo, Japan) and TSUNESHICHI TANAKA, ED. (Ritsumeikan University, Kyoto, Japan) Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. Vol. 1, 650 p.; vol. 2, 712 p.; vol. 3, 643 p.; vol. 4, 623 p. For individual items see A92-19677 to A92-19743, A92-19745 to A92-19844.

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The present conference on fatigue and fatigue thresholds encompasses nonmetallic and/or advanced materials such as composites, ceramics, electronic materials, and biomaterials, as well as life prediction, computer-assisted fatigue technologies, and aerospace engineering structures including adhesive joints. Specific issues addressed include planar slip in fcc stainless steels, the AlMgSi-alloy fatigue mechanism, the microstructure and crack growth associated with Ti-2.5Cu, the performance of Ti alloys at cryogenic temperatures, the influence of surface condition on fatigue strength, and the role of small defects in high-cycle fatigue. Also addressed are the multiaxial load spectra in a cooled gas-turbine blade under in-service conditions, variable amplitude loading/strength, multiaxial loading, mixed-mode crack growth, the effects of prestress overload on LCF and da/dN , notch effects, and contact fatigue. C.C.S.

A92-19679

FATIGUE PROBLEMS IN LIFE PREDICTION

HIDEO KITAGAWA (Nihon University, Tokyo, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 1. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 45-54.

Copyright

The present and future problems in the fatigue-related life prediction (LP) and the role of fatigue in LP are discussed. Three regions for LP are mentioned: the low-cycle fatigue region, the low-stress long-life region, and the random excess region (the near-threshold region). Examples of developments in the fatigue-related LP are discussed. Author

A92-19752

SIGNIFICANCE OF SMALL-CRACK GROWTH LAW IN FATIGUE BEHAVIOR OF MATERIALS

H. NISITANI (Kyushu University, Fukuoka, Japan), M. GOTO (Oita University, Japan), and N. KAWAGOISHI (Kagoshima University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1067-1072. refs

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This paper presents two fatigue crack growth laws which apply to large and small cracks, respectively, and express the crack growth rate of ductile materials. A unifying explanation for two growth laws is made on the basis of the assumption that dl/dN is

proportional to the reversible plastic zone size. A convenient method based on small-crack growth law is proposed for predicting the fatigue life of plain members. P.D.

A92-19761

MICROSTRUCTURAL EFFECT ON PROPAGATION OF SHORT FATIGUE CRACKS IN NOTCHED COMPONENTS

Y. AKINIWA (Kyushu Institute of Technology, Kitakyushu, Japan) and K. TANAKA (Kyoto University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1121-1126. refs
Copyright

Single-edge-notched specimens of a low-carbon steel and an aluminum alloy were fatigued under cyclic in-plane bending. The resistance curve was constructed in terms of the threshold value of the maximum stress intensity factor. The predicted values of the fatigue limit of crack initiation, the fatigue limit of fracture, and the nonpropagating crack length agree very well with the experimental results. Author

A92-19776

EVALUATION OF CRACK OPENING STRESS DISTRIBUTIONS AND STRESS INTENSITY FACTORS BASED ON OPENING DISPLACEMENTS ALONG A FATIGUE CRACK

K. HONDA (Okayama University, Japan) and T. TORII IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 2. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1307-1312. refs
Copyright

A method is presented by which factors controlling fatigue crack propagation can be obtained from a profile itself of the crack opening displacement. The estimated crack opening stress distribution, which was smaller specifically near the fatigue crack tip than the applied stress, was in fairly close agreement with the value that superposed the applied stress upon the X-ray residual stress near the fatigue crack. The stress intensity factor assessed from this crack opening stress distribution was useful in evaluating the fatigue crack propagation rate in a construct of the effective stress intensity factor range. Author

A92-19784

FATIGUE CRACK GROWTH UNDER VARIABLE AMPLITUDE LOADINGS

MASAHIRO JONO (Osaka University, Suita, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 3. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1485-1498. refs
Copyright

Fatigue crack growth under stationary and nonstationary variable amplitude loadings were extensively investigated and crack closure behaviors and prediction methods of fatigue crack growth rates were discussed in detail. Growth behaviors under varying loading conditions of small fatigue cracks and elastic-plastic fatigue cracks were also discussed. Author

A92-19788

HIGH TEMPERATURE CREEP-FATIGUE FAILURE CRITERIA FOR ENGINEERING MATERIALS

MASAKI KITAGAWA, ISAMU NONAKA, and KEIJI SONOYA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 3. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1537-1546. refs
Copyright

Two creep-fatigue life criteria are proposed from an engineering standpoint: one for estimating creep-fatigue life only from creep rupture and fatigue life data and the creep-fatigue-ratchet failure criteria for loading conditions where grain boundary sliding is the

main cause of cyclic failure. Predictions based on both of the proposed methods were compared with experimental data for assessment of their accuracy. Author

A92-19807

A STUDY ON THE FRACTURE SURFACE USING THE X-RAY FRACTOGRAPHY

YOSHITAKA NATSUME, SUSUMU MIYAKAWA, and TSUYOSHI MURAMATSU (Nippondenso Co., Ltd., Kariya, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1979-1984. refs
Copyright

The residual stress distribution and the integral breadth distribution on the actual fracture surface of extremely hard material were investigated by using the microbeam X-ray stress measurement technique. It provides useful information for fracture analysis of such material. A result of the presumption of the actual fracture stress is given. Author

A92-19813

MONTE CARLO SIMULATION OF SMALL FATIGUE CRACK PROPAGATION

K. TANAKA, M. KINEFUCHI (Kyoto University, Japan), and Y. AKINIWA (Kyushu Institute of Technology, Kitakyushu, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2137-2142. refs
Copyright

The continuous distribution of dislocations was used to model the slip deformation ahead of the tip of a small fatigue crack interacting with grain boundaries. By assuming that the crack growth rate was controlled by the crack-tip opening displacement, a Monte Carlo simulation of the growth of a crack nucleated in the weakest grain was conducted with the grain structure whose grain size and frictional stress were random variables following two-parameter Weibull distributions. Fast and irregular propagation behavior of small cracks was nicely derived from simulation. The effects of microstructural parameters on the propagation behavior of small cracks and on the crack propagation life were discussed on the basis of the simulation results. Author

A92-19814

STOCHASTIC SIMULATION OF INITIATION AND GROWTH OF SMALL SURFACE CRACKS IN CREEP-FATIGUE CONDITION

R. OHTANI, T. KITAMURA, and N. TADA (Kyoto University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2143-2148. refs
Copyright

Initiation and growth of surface small cracks during creep-fatigue were numerically simulated based on a quasi-three-dimensional model of random fracture resistance of grain boundary facets. Microstructural inhomogeneity, which brings about fluctuation on the initiation and growth, was modeled using stochastic variables. The interactions between cracks, such as crack coalescence and stress relaxation in the vicinity of large cracks, were also taken into consideration in the model. The simulation result coincided well with the experimental observation throughout the creep-fatigue life. Author

A92-19816

A MODELING OF CRACKING BEHAVIOR IN MULTIAXIAL LOW CYCLE FATIGUE AND ITS APPLICATION TO LIFE ASSESSMENT

T. HOSHIDE and T. INOUE (Kyoto University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4.

39 STRUCTURAL MECHANICS

Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2161-2166. refs
Copyright

A model of fatigue crack growth under multiaxial stresses is developed in this study to evaluate the fatigue life. In the modeling, hexagonal elements with a double slip system are used as grains in a polycrystalline material. An analytical procedure for crack growth is established based on a competition between the growth due to crack linkages and the propagation of a dominant crack as a single crack. Cracking morphology observed experimentally are well simulated by using the proposed model. The fatigue life is evaluated by the present procedure with a statistical technique of the Monte Carlo type. The prediction including the statistical scatter-band coincide with the experimental results. Author

A92-19824

REMAINING LIFE PREDICTION OF FATIGUE CRACKS PROPAGATING IN RESIDUAL STRESS FIELDS

KIYOTSUGI OHJI, SHIRO KUBO, and MASAHIRO TSUJI (Osaka University, Suita, Japan) IN: *Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds*, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2377-2382. refs
Copyright

A method was proposed by the present authors for predicting growth rates da/dN and the remaining lives of fatigue cracks propagating in residual stress fields. By incorporating an inverse scheme, this approach can be applied to cases where residual stresses redistributed due to crack initiation and propagation are given. In the present paper the effect of errors involved in the measurement of redistributed residual stresses on the estimated da/dN and the remaining lives are assessed theoretically and numerically. The proposed method for estimating da/dN and lives is found insensitive to errors in the measurement of residual stresses. Monte Carlo simulations revealed that the estimated value of da/dN follows normal or log-normal distribution and that proposed expression estimating the variance of $\ln(da/dN)$ is useful. Author

A92-19825

FATIGUE LIFE PREDICTION FROM THE VIEWPOINT OF INTERNAL STRESS AND EFFECTIVE STRESS

Y. IKAI and M. MATSUDA (Kobe University, Japan) IN: *Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds*, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2383-2388. refs
Copyright

The present study focuses attention on fatigue-life prediction under varying stress from the viewpoint of internal stress and effective stress. Since not all of applied stress but effective stress causes fatigue damage, a fatigue-damage-evaluation model is discussed on account of effective stress rather than applied stress. A method is shown to estimate effective stress under varying applied stresses. Combining these two, the fatigue damage model is examined in several sequences. Author

A92-19831

FATIGUE LIFE PREDICTION UNDER INTERMITTENT STRESS/STRAIN CYCLING

TAKESHI HORIKAWA and HIROSHI NAKAMURA (Ryukoku University, Otsu, Japan) IN: *Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds*, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2441-2446. refs
Copyright

Fatigue on the intermittent stress/strain cycling has been investigated in order to develop fatigue life prediction method of piston crown of diesel engine and turbine blade. Many test results have been obtained, and it is found that the fatigue life under the cycling is shorter than that of the constant mean stress. So, new-life

prediction method is needed in the field of fatigue design of the machine. Work has been conducted on the intermittent stress/strain cycling fatigue. The purpose of this paper is to propose the life prediction method under the intermittent stress/strain cycling, and to investigate usefulness of the method based on the experimental results which were conducted with carbon steel, stainless steel and superalloy. Author

A92-19834

FRACTURE MECHANICS APPROACH TO THE EVALUATION OF FATIGUE CRACK PROPAGATION OF ADHESIVE JOINTS

H. ISHIKAWA, S. NAKANO (University of Electro-Communications, Chofu, Japan), R. YUUKI, and N. Y. CHUNG (Tokyo, University, Japan) IN: *Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds*, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2487-2492. refs
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Various types of adhesive-joint specimens with a crack in an adhesive layer are prepared for the fatigue tests. Comprehensive mixed-mode conditions from pure mode I to nearly pure mode II are realized. It is found that the fatigue-crack growth rate in various adhesive joints can be well characterized by the total energy-release-rate range, which can be evaluated by the measurement of the compliance of the specimen. Author

A92-19836

FATIGUE LIFE PREDICTION OF ADHESIVE BONDED JOINTS

MAKOTO IMANAKA, WAICHIRO KISHIMOTO, KOZO OKITA (Hyogo Prefecture, Industrial Research Institute, Kobe, Japan), and HIDEAKI NAKAYAMA (Osaka Sangyo University, Daito, Japan) IN: *Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds*, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2499-2504. refs
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Fatigue tests were conducted on adhesive bonded butt, lap and tube fitted joints bonded with the same adhesive. In order to standardize the fatigue strength of these adhesive joints, the compiled S-N data were evaluated with several maximum stress components determined by finite element method. Then, these standardized fatigue strength data were compared with the fatigue strength data of butt joint. The results indicate that fatigue strength of lap and tube fitted joints can be estimated from the fatigue strength of butt joint on the bases of maximum stress normal to the adhesive/adherent interface. Author

A92-19840

EXPERIMENTAL STUDIES OF SURFACE CRACK GROWTH IN THIN PLATE SPECIMEN

F. TAKEMASA, T. UEMURA, S. TAKEDA, K. KAMATA, and Y. NAKAMURA (Ishikawajima-Harima Heavy Industries Co., Ltd., Structure and Strength Dept., Tokyo, Japan) IN: *Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds*, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2533-2538. refs
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Experimental studies for the surface fatigue crack growth behavior were carried out on thin plates under 0.001 m thick. The strain on the back surface of the crack, the crack growth patterns, and the crack growth rate on the specimen surface were measured. An attempt was made to apply the crack mouth opening displacement range as a parameter of the surface fatigue crack growth rate on thin plates. Author

A92-20518

FINITE ELEMENT METHOD (FEM) ANALYSIS OF ELASTIC-LINEAR-HARDENING MATERIALS AND COMPARISON WITH MEASUREMENTS ON COMMERCIAL MATERIALS

YUKITAKA MURAKAMI (Kyushu University, Fukuoka, Japan) and

LI P. YUAN Journal of Testing and Evaluation (ISSN 0090-3973), vol. 20, Jan. 1992, p. 15-24. refs
Copyright

The correlation of Brinell hardness with the yield stress, tensile stress, and strain hardening modulus H is analyzed for several elastic-linear hardening materials and commercial materials, including steels, copper, and alloys. It is found, in particular, that the empirical formula $\sigma(b)/H(b) = 3.5$ holds only for materials with a relative hardening modulus of less than 2.5. Materials with a small hardening modulus H and the same yield stress show a higher pile-up on the specimen surface. Sinking indentation shapes appear only for materials with large H . For materials with similar yield stress values, there is no appreciable difference in the size of the plastic zone regardless of the values of H in the range 980-9800 MPa. V.L.

A92-21211

A RECTANGULAR CRACK IN AN INFINITE SOLID, A SEMI-INFINITE SOLID AND A FINITE-THICKNESS PLATE SUBJECTED TO TENSION

M. ISIDA (Kurume Institute of Technology, Japan), T. YOSHIDA (Nippon Steel Corp., Material Forming Process Laboratory, Kitakyushu, Japan), and H. NOGUCHI (Kyushu University, Fukuoka, Japan) International Journal of Fracture (ISSN 0376-9429), vol. 52, Nov. 15, 1991, p. 79-90. refs

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This paper is concerned with the tension problems of a semiinfinite solid with an embedded rectangular crack and a rectangular surface crack as well as an infinite solid with a rectangular crack as a special case. The analyses are based on the body force method, and are performed by generalizing the previous analyses of an embedded elliptical crack and a semielliptical surface crack. Furthermore, approximate results are given for a finite-thickness plate with an embedded rectangular crack, by superposing the effects of the free surfaces obtained in the above analysis for a semiinfinite solid. Author

A92-22523

AN ANALYSIS OF IMPACT RESISTANCE OF COMPOSITE FAN BLADE

TOSHIO MIYACHI, HIDEHITO OKUMURA, KUNIHICO OHTAKE, and YASUSHI SOFUE Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 35-44. In Japanese. refs

An analysis of impact resistance of composite fan blades for turbofan engines has been conducted. Analytical models of composite blade of different sizes and materials were composed and impact resistance was evaluated by the analysis. The validity of the analytical model was confirmed by comparison of the analytical result with the experimental result of natural vibration of the titanium blade model of the same configuration as the composite blade models. The transient response produced by simulated bird strike on the blade model was analyzed with the finite element method which includes bird impact load model and geometrical nonlinearity. The validity of the analytical method was confirmed by comparing the analytical results with the experimental results of some impact tests of the titanium blade models. The results show that polymer matrix composite blades have much lower impact resistance than titanium blade and it is clear that the composite blade of same size as the titanium blade is entirely broken by the bird strike, and 1.65 and 2.06 times larger-size composite blades are partially broken by the bird strike. Author

A92-23109

AN ANALYSIS OF IMPACT RESISTANCE OF COMPOSITE BLADES FOR TURBO-FAN ENGINES

T. MIYACHI, H. OKUMURA, K. OHTAKE, and Y. SOFUE (National Aerospace Laboratory, Chofu, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 87-94. refs

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An analysis of impact response of composite fan blades of turbo-fan engines is conducted. The validity of analytical model and analytical method were confirmed by comparing the analytical results with the experimental results of natural vibration and impact response of the titanium-alloy blade of the same configuration of one of the composite blades. The results show that the polymer-matrix composite blade cannot endure a 1.5-lb bird strike which is one of the requirements of the airworthiness standards. To endure the bird strike, it is suggested that application of metal-matrix composites and/or superhybrid structures is necessary. Author

A92-23111

NONLINEAR TRANSIENT ANALYSIS OF COMPOSITE ATP BLADE MODEL

HIDEHITO OKUMURA, KUNIHICO OHTAKE, AKINORI OGAWA, RYOSAKU HASHIMOTO (National Aerospace Laboratory, Chofu, Japan), TOSHIHIRO KAWASHIMA, YASUYUKI TANAKA, and TADASHI NATUMURA (Ishikawajima-Harima Heavy Industries Co., Ltd., Mizuho, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 103-110. refs

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A computational simulation for the transient response problem of the composite ATP blade model subjected to local impact loading with foreign objects is presented using geometrically nonlinear finite element analysis. In this numerical study, two remarkable things were found. One is that initial deformation patterns of plate model due to impact on local region are similar to higher order vibrational eigenmodes. Another thing is that existence of flexural edge wave in the region of the leading edge and the trailing edge of the ATP blade model was confirmed for the first time in computer simulations. It was found that delaminations of the leading edge in experimental results presented in the literature were related to this edge wave propagation along the free boundary. Author

A92-23116

FLEXURAL DEFORMATION AND FRACTURE BEHAVIOR OF ADVANCED COMPOSITE STRUCTURES

H. TAKAYANAGI (Agency of Industrial Science and Technology, Industrial Products Research Institute, Tsukuba, Japan), H. SEMBOKUYA (Takushoku University, Hachioji, Japan), K. KEMMOCHI, M. HOJO (Agency of Industrial Science and Technology, Industrial Products Research Institute, Tsukuba, Japan), and H. MAKI (Takushoku University, Hachioji, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 161-168. refs

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Three kinds of I-beam structures were fabricated out of carbon fiber and epoxy resin. The changes of fiber-volume fraction due to the position of I-beams were measured in detail. The strength, stiffness and shear-lag effect of I-beams with different stacking sequences was investigated. The distribution of fiber volume fraction of the I-beam, whose ply orientation of flange was quasi-isotropic, was less scattered than the other beams. There were differences of the fracture modes between the specimens subjected to bending load. The experimentally determined strains and deflections of I-beams were compared to the values calculated based on a classical beam theory and 3D FEM analysis. The experimental results of the I-beam, whose ply orientation in flange was quasi-isotropic or angle-ply, agreed well with the value calculated based on the classical beam theory. The experimental result of I-beam whose ply orientation in flange was unidirectional, agreed well with the result of FEM analysis owing to a shear-lag effect. Author

A92-23117

ENERGY RELEASE RATE OF DELAMINATION AT TRANSVERSE CRACK TIPS

39 STRUCTURAL MECHANICS

KYOHEI KONDO (Tokyo, University, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 169-176. refs
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Delamination at the tips of transverse cracks in the 90-deg ply of a composite laminate under mechanical loading results in the fracture of the laminate due to strain concentration of the adjacent plies. A closed-form expression for the potential-energy-release rate associated with delamination growth is obtained utilizing the superposition method and the classical lamination theory. The present result is compared with that obtained by O'Brien based on the compliance change due to the delamination growth. The delamination-onset strains for some laminates are predicted, clarifying the influences of the angle and the number of the 90-deg plies on the fracture of the laminates. Author

A92-23123

A FINITE ELEMENT ANALYSIS MODEL OF INTERLAMINAR DELAMINATION OF LAMINATED COMPOSITES

SHIRO TAKADA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan), ISAO KIMPARA, and ISAMU OHSAWA (Tokyo, University, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 219-226. refs
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Energy release rate and interfacial delamination energy are examined as parameters to evaluate interlaminar delamination of unidirectional CFRP. A new finite element model in which bond spring elements are introduced (both normal and shear directions) between every node of plane elements is applied to calculate energy release rate of interlaminar delamination of notched CFRP under four-point flexural load condition. Furthermore, a four-point flexural test of notched CFRP is carried out and the start of interlaminar delamination from the root of a notch is detected by acoustic emission monitoring. It is shown that critical energy release rate and interfacial delamination energy are independent of the depth of a notch, which are effective for evaluating interlaminar delamination. Author

A92-23127

STRESS ANALYSIS OF THICK WALLED CROSS-PLY COMPOSITE CYLINDRICAL SHELLS TAKING ACCOUNT OF CURING STRESSES

O.-M. BYON (Nihon University, Narashino, Japan) and JACK R. VINSON (Delaware, University, Newark) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 257-264. refs
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The effects of thermal residual stresses and strains, boundary conditions at both ends of shells, and stacking sequences in composite material systems on the design of thick-walled cross-ply composite cylindrical shells are examined by using a simple finite-cylindrical-element method formulated in a previous paper. Although the thermal residual strain reduces the maximum tensile radial strain, its maximum value is still high and can cause an interlaminar failure of the thick-walled cross-ply composite cylindrical shell. An optimal stacking sequence of laminated cross-ply composite cylindrical shells among five stacking sequence models is also proposed to give the smallest values of the radial strain and the compressive stress in the fiber direction. Author

A92-23128

VISCOELASTIC NUMERICAL METHODS FOR STABLE AND UNSTABLE METAL MATRIX COMPOSITE MATERIALS

KURT C. GRAMOLL (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S.

Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 273-281. Research supported by MOESC and NSF. refs
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The viscoelastic creep of a two-part metal matrix composite material where the fiber is elastic and the matrix is viscoelastic is examined. Two new creep models using a variable time (VT) dashpot, and a variable time/nonlinear stress (VTNS) dashpot are introduced. These models allow modeling decreasing, steady state, and increasing creep rates, plus nonlinear stress effects, all of which are common to the creep of metals. The solution of a standard three-parameter solid using the VT and VTNS dashpots is presented which then can be used to model an elastic fiber in a viscoelastic matrix. These solutions are then used to compare the accuracy of various numerical methods in predicting the creep of viscoelastic composite materials. Two commonly used numerical methods for predicting creep are examined and found to deviate from the closed-form solutions, particularly for materials with increasing creep rates. An additional numerical method based on the creep rate is presented and found to agree well with the exact solutions. Author

A92-23134

ANISOTROPIC THERMAL EXPANSION AND THERMOMECHANICAL HYSTERESIS OF MULTIDIRECTIONALLY REINFORCED METAL MATRIX COMPOSITES - AN ELASTIC-PLASTIC ANALYSIS

K. WAKASHIMA and H. TSUKAMOTO (Tokyo Institute of Technology, Yokohama, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 337-345. Research supported by Science and Technology Agency of Japan. refs
Copyright

On the assumption that effectively homogeneous plastic deformation occurs in the matrix obeying the Levy-Mises flow rule, elastic-plastic analysis based on a generalized Eshelby model is developed for the prediction of the anisotropic thermal expansion/contraction behavior of multidirectionally fiber-reinforced metal matrix composites. It is shown that the problem is reduced to a constrained minimization problem which can be solved by numerical techniques of nonlinear programming. Results are presented for aluminum matrix composites reinforced with (+/- theta) and (0/90/+/- theta) fibers of isotropic silicon carbide or anisotropic carbon. Author

A92-23144

SUCCESSIVE ITERATION METHOD APPLIED TO A COMPOSITE CONTAINING SLIDING INCLUSIONS - OVERALL ELASTIC CONSTANTS

SHOICHI SHIBATA (Tokyo Institute of Technology, Yokohama, Japan), IWONA JASIUK (Michigan State University, East Lansing), T. MORI (Tokyo Institute of Technology, Yokohama, Japan), and T. MURA (Northwestern University, Evanston, IL) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 429-436. Research supported by Nippon Steel Corp. refs

(Contract DAAL03-89-K-0019; NSF MSM-88-10920)

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Using a successive iteration method with the average field theory, the effective shear modulus and Poisson ratio of a composite containing spherical sliding inclusions are calculated. This method consists of two parts. First, a single sliding inclusion problem is solved in which the tangential traction vanishes. Next, the above result is extended to the composite which contains randomly distributed sliding inclusions. To this end, a successive iteration method is applied with the average field theory to account for the interaction among all the sliding inclusions. The analytical forms of the effective elastic constants are evaluated in closed

forms. The kinetics of sliding and the relaxation time and strength are also given. Author

A92-23151

PROGRESSIVE CRACKING IN CFRP CROSS-PLY LAMINATES
HIROICHI OHIRA (Kyushu University, Fukuoka, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 497-504. refs
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Experimental stress-strain diagrams of a (0/90/5/1)s and a (0.90)s carbon/epoxy laminate under tension are given, and the progressive cracking is examined based on a new concept of the failure mechanism of a glass/epoxy cross-ply laminates under tension. A similar failure process could be expected also to CFRP. However, the difference is considerable. Oblique cracks were not observed in CFRP specimens. The characteristics of experimental stress-strain diagrams are examined theoretically. Qualitative agreement of the stepped diagrams with theory is reported.

Author

A92-23152

MULTIPLE FRACTURE PHENOMENON IN COMPOSITES

S. OCHIAI, K. OSAMURA (Kyoto University, Japan), P. W. M. PETERS, and K. SCHULTE (DLR, Institut fuer Werkstoff-Forschung, Cologne, Federal Republic of Germany) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 505-512. refs

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Tensile tests are conducted on a tungsten-fiber/Cu matrix and a graphite/epoxy composite to study multiple fractures, and the results are compared to those of a shear-lag analysis and a Monte Carlo simulation. The graphite/epoxy composite is a cross-ply laminate with a 90-deg ply in a (0/90/0) matrix, and 100-micron single tungsten fibers are used in the Cu-matrix composite wire. The load-strain curves for the tungsten/Cu wires show that fractures occur in both composites depending on applied stress and volume fraction of fiber or 90-deg ply. Stress-transfer capacity is found to depend on the volume fraction of fiber because the aspect ratio varies directly with volume fraction of fiber. The simulation provides similar results and confirms the multiple fractures of the fiber in single-fiber composites and in the 90-deg ply in cross-ply composites. C.C.S.

A92-23155

ON THE DIRECTION OF INITIAL FAILURE PROPAGATION IN A UNIDIRECTIONAL COMPOSITE MODEL

HIROSHI FUKUDA (Tokyo, Science University, Noda, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 529-534. refs

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It is important to know the direction of initial failure propagation in composites to understand mechanical properties of composites. This paper first calculates the stress distribution around a broken fiber in two cases: (1) where a crack propagates in the matrix and (2) where the fiber-matrix interface is debonded. Using the numerical results, the strain energy release rate for both the matrix cracking and the interfacial debonding is calculated. A suggestion for the bonding design is presented. Author

A92-23156

TEMPERATURE DEPENDENCE OF FATIGUE BEHAVIOR OF C/A HYBRID UNIDIRECTIONAL FRP LAMINATES

M. NAKADA, Y. MIYANO, M. SUZUKI, and Y. HATTORI (Kanazawa Institute of Technology, Ishikawa, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan,

June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 543-550. refs

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To investigate the temperature dependence of the fatigue behavior of carbon/aramid hybrid unidirectional fiber-reinforced-plastic (FRP) laminates (C/A hybrid FRP) in which carbon FRP (CFRP) layer was sandwiched between two aramid FRP (AFRP) layers, three point bending fatigue tests for CFRP, AFRP, and C/A hybrid FRP were conducted at several levels of temperature and loading rate. The flexural fatigue fracture of C/A hybrid FRP is classified into two modes by temperature and/or the number of cycles to failure $N(f)$. One is the tensile fracture of the AFRP layer in the range of low temperature and/or low $N(f)$ where the fatigue strength changes scarcely with temperature and $N(f)$. The other is the compressive fracture of the CFRP layer in the range of high temperature and/or high $N(f)$ where the fatigue strength changes remarkably with temperature and $N(f)$. Furthermore, the reciprocity law between time and temperature holds for the flexural fatigue strength of C/A hybrid FRP, as well as CFRP and AFRP. Author

A92-23157

INELASTIC BEHAVIOR AND MICROSTRUCTURAL CHANGE OF GRAPHITE/EPOXY (+/-45 DEG)₄ TUBES UNDER MULTIAXIAL LOADING

Y. KANAGAWA, S. MURAKAMI, M. NAKAYAMA, T. ISHIDA (Nagoya University, Japan), and E. TSUSHIMA (Tonen Corp., Corporate Research and Development Laboratory, Saitama, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 551-558. refs
Copyright

Characterization of inelastic deformation of graphite/epoxy composites under multiaxial cyclic loading and the identification of their damage mechanisms are discussed with a special emphasis on the interrelation between the viscoplastic behavior of the matrix and microstructural defects in composites. The combined tension, compression, and torsion were applied to tubular specimens of graphite-fiber-reinforced plastics. The specimens had a lamination geometry of (+/- 45 deg)₄ fabricated from prepreg Toray P3052. Stiffness reduction were calculated from stress-strain hysteresis loops in the damage process during the course loading of specific stress levels and stress ratios. Micrographical observation was performed to identify microcracks in the matrix of off-axis plies, delaminations, and fiber breakage on the cross section at several stages of material damage. Author

A92-23159

STRESS ANALYSIS ON RECTANGULAR PLATE OF CROSSPLY LAMINATES WITH AN ELLIPTICAL HOLE

TAKAYA HAYASHI and YASUHIRO FUJIWARA (Tokai University, Hiratsuka, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 567-574. refs
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A method of theoretical analysis for the titled problem is developed on the basis of anisotropic plane elasticity, which is an extension of a previous report by Hayashi (1988) concerned with circular hole. Modification of theory has been done on conformal function. Sample studies are carried out by the theory, finite element method, and tests on specimens of crossply laminate and aluminum alloy plate. The type of plate has a hole-radius ratio 2 longitudinally, a rectangular aspect ratio 2.5, and a hole-width ratio 0.5. Upon a comparison, the results have appeared well consistent. Stress concentration factors around the hole are also presented for several kinds of parameter. Author

A92-23161

STRESS DISTRIBUTION ALONG HOLE PERIPHERY OF ORTHOTROPIC PLATES IMPOSED BOLT CONTACTING PRESSURE

39 STRUCTURAL MECHANICS

TATSUO OGASA, HITOSHI YOSHIDA (Agency of Industrial Science and Technology, Industrial Products Research Institute, Higashi, Japan), and TAKASHI AKASAKA (Chuo University, Tokyo, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 583-590. refs
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Stress distribution along the hole periphery of orthotropic plates with imposed bolt contact pressure is analyzed within the limit of elasticity without loss of generality. Frictionless contact between plate and rigid pin is assumed. Load distribution on the contact part of hole periphery is represented by a series containing undetermined coefficients and by an undetermined contact angle. The stress function is solved from the equation of compatibility for this particular load distribution and formulas giving displacement and stress components are derived implicitly. Undetermined coefficients for the set of elastic constants of CFRP angle plies are solved from the condition of rigid contact by preassigning the contact angle. The contact angle which offers determined coefficients consistent with the geometrical condition and possessing the best convergence is detected for each of elastic constants. Author

A92-23165

COMPRESSIVE BEHAVIORS OF COMPOSITE PANELS WITH A DELAMINATION

HIROSHI SUEMASU (Sophia University, Tokyo, Japan) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 637-644. refs
Copyright

Both experimental and analytical techniques are employed to examine the behavior of glass/polyester composite panels during compressive buckling and postbuckling. The rectangular panels are held by four corner clamps, and the load and transverse strains are measured at five points on the surface. Experimentally observed phenomena include complex mechanisms such as local delamination buckling, asymmetric buckling, and secondary buckling. The analysis is based on the Rayleigh-Ritz approximation and treats the panels as 2D panels with contact on the delamination surfaces. The analysis predicts the complex buckling and postbuckling events, and accurately describes the results. Local buckling stress varies indirectly with width and directly with depth of delamination, and the compressive stiffness is only slightly reduced due to the local delamination buckling. C.C.S.

A92-23166

STRENGTH OPTIMIZATION OF LAMINATED COMPOSITES USING TRANSFORMED DESIGN VARIABLES WITH RESPECT TO LAYER ANGLES

HISAO FUKUNAGA (National Aerospace Laboratory, Chofu, Japan) and GARRET N. VANDERPLAATS (VMA Engineering, Goleta, CA) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 645-652. refs
Copyright

The present paper treats a minimum weight design of laminated composites under in-plane loading based upon mathematical programming methods. Design variables are layer angles as well as layer thicknesses, and constraints consist of strength and displacement conditions. Use of transformed design variables is proposed in order to reduce the nonlinearity between the constraints and the layer angles. An approximation approach based upon the linear approximation of stress resultants is also applied to the optimization of laminated composites with multi-elements. Author

A92-23169

FREE VIBRATION ANALYSIS OF CANTILEVERED COMPOSITE RECTANGULAR PLATES

Y. NARITA (Hokkaido Institute of Technology, Sapporo, Japan) and A. W. LEISSA (Ohio State University, Columbus) IN: Achievement in composites in Japan and the United States; Proceedings of the 5th Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 24-27, 1990. Tokyo, Japan Society for Composite Materials, 1990, p. 679-686. refs
Copyright

This work presents an analytical approach and accurate numerical results for the free vibration of cantilevered, symmetrically laminated rectangular plates. The problem is solved by the Ritz method, and the natural frequencies are calculated for a wide range of parameters, e.g., composite material constants, fiber angles and stacking sequence. The results are compared to those in the existing literature, and the effects of varying the parameters upon the free vibration characteristics are discussed. Author

A92-24593

A TWO-DIMENSIONAL STRESS ANALYSIS OF BUTT ADHESIVE JOINTS FILLED WITH RIGID CIRCULAR FILLERS IN AN ADHESIVE SUBJECTED TO TENSILE LOADS

KATSUHIRO TEMMA (Kisarazu National College of Technology, Japan), TOSHIYUKI SAWA, and TETSU HIROSHIMA (Yamanashi University, Kofu, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, Jan. 1992, p. 30-37. refs
Copyright

This paper deals with a two-dimensional stress analysis of a butt adhesive joint with rigid fillers in an adhesive subjected to a tensile load. Assuming that adherends are rigid and replacing an adhesive with a finite strip including rigid fillers, the analysis was done using the two-dimensional theory of elasticity in order to examine the joint strength. The effects of the location and size of rigid fillers on the stress distributions around the fillers and at the interfaces were shown by numerical calculations. For verification, photoelastic experiments were performed. The analytical result was in fairly good agreement with the experimental result. It was seen that based on the amount of shift of the location and the filler diameter, the joint strength was more improved than that of the joints without fillers. Author

A92-24594

THEORETICAL PREDICTION OF SHEAR-BAND-TYPE STRAIN LOCALIZATION AND DISCUSSION ON ITS RELATION TO FRACTURE

MANABU GOTOH (Gifu University, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, Jan. 1992, p. 62-69. refs
Copyright

Gotoh's J2G constitutive equation is used to deduce the critical conditions for the vertical and oblique types of shear band bifurcation in a bar under severe axial compression. It is found that the vertical shear band is followed almost immediately by fracture, whereas the oblique shear band does not necessarily induce an immediate fracture and corresponds to oblique shear-band-like patterns appearing in materials under severe compressive plastic deformation, such as in rolling. In this case, an additional condition is required to predict the fracture strains. V.L.

A92-24928

A REFINED THEORY OF ANISOTROPIC THICK PLATES

SATORU IGARASHI and KATSUHISA SHIBUKAWA (Hokkaido University, Sapporo, Japan) IN: Advances in the theory of plates and shells. Amsterdam, Netherlands and New York, Elsevier, 1990, p. 27-44. refs
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A theory is advanced that permits the derivation of approximate equations and is applied to the general 2D equations of the n th-order approximation for the deformation of anisotropic plates. The theory allows the derivation of the deformation without changing the number of unknown functions by extending the matrix notation and equations developed by Igarashi (1988). In order to test the equations the method is applied to a graphite/epoxy composite plate subjected to a sinusoidally distributed load. The

approximate equations and the solution suggest that the approximate solution approaches the exact solution without increasing the order of approximation. The solution's accuracy is shown to vary indirectly with plate thickness and anisotropic strength, and a preliminary calculation is presented to calculate the upper limit of the application of the approximate solution.

C.C.S.

A92-25507

A NEW CONTROL TECHNIQUE BASED ON THE LAC/HAC CONCEPT FOR FLEXIBLE STRUCTURES

SHINJI HOKAMOTO and NORIHIRO GOTO Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 455, 1991, p. 686-693. In Japanese. refs

In this paper a new control technique based on the LAC/HAC concept is proposed to suppress the vibration of flexible space structures. The new technique employs the mechanism to turn on or off the HAC part of the LAC/HAC system in such a manner as to suppress the spillover effects as quickly as possible. The control system designed by the new technique has global stability and is more effective than a pure LAC system, even when an ordinary LAC/HAC system results in failure because of spillover instability. To show the characteristic features of the new technique and how to implement the system, computer simulation examples are given. Finally, the technique is applied to the transversal vibration control of a cantilever beam to show its effectiveness and practicality.

Author

A92-27374

STUDY OF THE BUCKLING LOAD OF STIFFENED SHELLS BY THE TRANSFER MATRIX METHOD [ERMITTLUNG DER BEULTRAGLASTEN AUSGESTEIFTER SCHALEN MIT HILFE VON UEBERTRAGUNGSMATRIZEN]

T. SHIGEMATSU (Tokuyama College of Technology, Japan), M. OHGA (Ehime University, Matsuyama, Japan), and T. HARA (Tokuyama College of Technology, Japan) Archive of Applied Mechanics (ISSN 0939-1533), vol. 62, Jan. 1992, p. 28-42. In German. refs

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The deformation and eigenvalue method using the transfer matrix are applied to ultimate strength analyses of axially compressed, stiffened cylindrical shells in the plastic range. The transfer matrix in the deformation method is obtained by suitable transformation of the stiffness matrix used in the finite element method, and the transfer matrix in the eigenvalue method is described by the linearized differential equation of shells. In the deformation method geometrical imperfections and residual stresses are taken into consideration, while in the eigenvalue method the former are not considered. The numerical results of stiffened shells obtained by both methods are illustrated and compared with each other.

Author

A92-27375

VIBRATION OF STIFFENED ANNULAR SECTOR PLATES USING THE SPLINE ELEMENT METHOD

T. MIZUSAWA (Daido Institute of Technology, Nagoya, Japan) Archive of Applied Mechanics (ISSN 0939-1533), vol. 62, Jan. 1992, p. 62-71. refs

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Vibrations of a stiffened annular sector plate with arbitrary boundary conditions are analyzed using the spline element method. The plate is idealized as a system of an annular sector plate and curved beams rigidly connected to each other. To demonstrate the accuracy of the present method several examples are solved, and the results are compared with those obtained analytically and by other numerical methods. Good accuracy is obtained. The effect of stiffening beams on the frequencies of stiffened annular sector plates is also investigated.

Author

A92-28053

ANALYTICAL METHOD FOR VIBRATION OF ANGLE-PLY CYLINDRICAL SHELLS HAVING ARBITRARY EDGES

Y. NARITA (Hokkaido Institute of Technology, Sapporo, Japan),

Y. OHTA, G. YAMADA, and Y. KOBAYASHI (Hokkaido University, Sapporo, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, March 1992, p. 790-796. refs

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A theoretical method is presented for solving the free vibration of angle-ply laminated cylindrical shells. The angle-ply laminated shell is macroscopically modeled as a thin shell of general anisotropy by using the classical lamination theory. The functional derived from the Flugge-type shell theory is minimized by following the Ritz procedure, and arbitrary combinations of boundary conditions at both ends are accommodated by introducing newly developed admissible functions. A computer code is made to verify the validity of the present method, and the natural frequencies and mode shapes of the laminated cylindrical shells are given for some typical edge conditions numerically.

Author

A92-28057

EFFECT OF STRUCTURAL DAMPING ON FLUTTER OF PLATES WITH A FOLLOWER FORCE

KEN HIGUCHI (Tokyo Denki University, Saitama, Japan) and EARL H. DOWELL (Duke University, Durham, NC) AIAA Journal (ISSN 0001-1452), vol. 30, March 1992, p. 820-825. Research supported by MOESC. Previously cited in issue 11, p. 1630, Accession no. A90-29417. refs

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A92-30095

A SMALL-CRACK GROWTH LAW AND ITS RELATED PHENOMENA

HIRONOBU NISITANI (Kyushu University, Fukuoka, Japan), MASAHIRO GOTO (Oita University, Japan), and NORIO KAWAGOSHISHI (Kagoshima University, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 41, March 1992, p. 499-501, 503-513. refs

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An expression of the crack-growth rate describing ductile materials is posited with comparisons to synthesized experimental data and theoretical analyses. The small-crack growth law and ultimate tensile strength are the key components of the analysis which attempts to unify the fatigue-crack growth laws for high and low nominal stresses. The rate of crack growth is assumed to be proportional to the reversible plastic zone size which permits the analytical connection of the two growth laws. The analysis leads to the introduction of mechanical properties into the defining equation, and the ultimate tensile strength is shown to be a key parameter. The crack-growth laws are applied to fatigue data related to loading pattern and material properties, and a method is described for predicting the fatigue life of carbon steel members. Of significant interest is the conclusion that the crack growth of a plain specimen is not determined by the range of the stress-intensity factors but by a combination of stress amplitude, crack length, and a constant n .

C.C.S.

A92-30097

ELASTIC-PLASTIC FRACTURE TOUGHNESS TEST UNDER MIXED MODE I-II LOADING

KEIICHIRO TOHGO and HITOSHI ISHII (Shizuoka University, Hamamatsu, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 41, March 1992, p. 529-540. refs

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Both analysis and experiment are utilized to develop an elastic-plastic fracture-toughness test based on a single-edge-cracked specimen subjected to shearing force and bending moment. The estimation of the J-integral for a crack undergoing mixed-mode I-II deformations is undertaken with two expressions called J-I and J-II. A deformation gage is developed for mixed-mode cracks to obtain an M-theta diagram (for bending moment and crack-opening angle) and a F-U diagram (for shearing force and crack-shearing displacement). Experiments are conducted with an aluminum alloy to determine elastic-plastic fracture toughnesses, and the mixed-mode cracks are found to lead to tensile-type or shear-type ductile crack initiation. Loading mode is the determining factor for crack-initiation type and

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characterization as either brittle or ductile, and two curves are presented which describe the conditions for crack initiation.

C.C.S.

A92-30116

TRANSFORMATION OF A NONLINEAR KINEMATIC HARDENING RULE TO A MULTISURFACE FORM UNDER ISOTHERMAL AND NONISOTHERMAL CONDITIONS

N. OHNO and J. D. WANG (Nagoya University, Japan) *International Journal of Plasticity* (ISSN 0749-6419), vol. 7, no. 8, 1991, p. 879-891. refs

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A nonlinear kinematic hardening rule with back stress decomposed into components is transformed to a multisurface form. First it is shown under isothermal conditions that the multisurfaces generated by the transformation are nested and obey a Mroz-type translation rule. It is also shown that the multisurface form can be specialized to a piecewise linear kinematic hardening rule. The transformation is then applied to a time recovery term describing thermal softening and a temperature-rate term operating in nonisothermal inelasticity. A multisurface model is thus derived for nonisothermal, as well as isothermal, plasticity and viscoplasticity.

Author

A92-30677

NONLINEAR HYDROELASTIC VIBRATION OF A CYLINDRICAL TANK WITH AN ELASTIC BOTTOM, CONTAINING LIQUID. I - EXPERIMENT

M. CHIBA (Iwate University, Morioka, Japan) *Journal of Fluids and Structures* (ISSN 0889-9746), vol. 6, March 1992, p. 181-206. Research supported by MOESC. refs

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Experimental studies have been carried out on the nonlinear hydroelastic vibrations of a circular cylindrical container with an elastic bottom plate, but otherwise rigid, and partially filled with water. The nonlinearities of the responses of the liquid and the bottom plate were investigated for various liquid heights. The influence of the flexibility of the bottom on the linear natural frequencies of the sloshing response was investigated, as well as the influence of the liquid on the linear natural frequencies of the bulging-type response, using the test tank with a flexible bottom plate of two kinds of polyester sheet: 0.25 mm and 0.35 mm thick. The characteristics of dynamic coupling between bottom plate motion and liquid motion change with liquid height; e.g., the maximum amplitude of the free surface, when the bottom plate is harmonically vibrating, varies with liquid height, and the maximum amplitude of the bottom plate, when the edge of the bottom is excited with constant amplitude, also depends on the liquid height. Furthermore, a free surface wave generated by the vibrating bottom plate is due to a parametric response in the case of low liquid height, while in a moderately higher liquid height, it is a forced response to the vibration.

Author

A92-31560

BONDED BI-MATERIAL HALF-PLANES WITH SEMI-ELLIPTICAL NOTCH UNDER TENSION ALONG THE INTERFACE

NORIO HASEBE (Nagoya Institute of Technology, Japan), MIKIYA OKUMURA (Tokyo Construction Co., Ltd., Japan), and TAKUJI NAKAMURA (Nagoya Institute of Technology, Japan) *ASME, Transactions, Journal of Applied Mechanics* (ISSN 0021-8936), vol. 59, March 1992, p. 77-83. refs

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A problem of two bonded, dissimilar half-planes containing an elliptical hole on the interface is solved. The external load is uniform tension parallel to the interface. A rational mapping function and complex stress functions are used and an analytical solution is obtained. Stress distributions are shown. Stress concentration factors are also obtained for arbitrary lengths of debonding and for several material constants. In addition, an approximate expression of the stress concentration factor is given for elliptical holes and the accuracy is investigated.

Author

A92-31566

CHAOTIC DYNAMICS OF A QUASI-PERIODICALLY FORCED BEAM

K. YAGASAKI (Tamagawa University, Tokyo, Japan) *ASME, Transactions, Journal of Applied Mechanics* (ISSN 0021-8936), vol. 59, March 1992, p. 161-167. refs

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A straight beam with fixed ends, forced with two frequencies is considered. By using Galerkin's method, the equation of motion of the beam is reduced to a finite degree-of-freedom system. The resulting equation is transformed into a multi-frequency system and the averaging method is applied. It is shown, by using Melnikov's method, that there exist transverse homoclinic orbits in the averaged system associated with the first-mode equation. This implies that chaotic motions may occur in the single-mode equation. Furthermore, the effect of higher modes and the implications of this result for the full beam motions are described.

Author

A92-32023

FRACTURE CRITERIA ON KINKING OF A CRACK OUT OF THE INTERFACE IN DISSIMILAR MATERIALS

RYOJI YUUKI and JIN-QUAN XU (Japan Society of Mechanical Engineers, Transactions A (ISSN 0387-5008), vol. 56, Sept. 1990, p. 1945-1951. In Japanese. refs

Consideration is given to fracture criteria on kinking of an interface crack out of the interface in dissimilar materials based on the maximum stress concept similar to the mixed-mode fracture criterion for a crack in a homogeneous material. If the bimaterial constant epsilon of dissimilar materials is zero or small, the kinking angles can easily be determined independent of the distance r from a crack tip. However, if epsilon becomes large, the kinking angles cannot be determined and the angles strongly depend on the distance r due to the oscillation singularity. This criterion is compared with the energy release rate criterion of He and Hutchinson.

Author

A92-32025

THE BIFURCATION MODE OF CREEP BUCKLING OF A CIRCULAR CYLINDRICAL SHELL UNDER AXIAL COMPRESSION

SEIYA HAGIHARA, NORIYUKI MIYAZAKI, TAKASHI UEDA, and TSUYOSHI MUNAKATA (Japan Society of Mechanical Engineers, Transactions A (ISSN 0387-5008), vol. 56, Sept. 1990, p. 1957-1961. In Japanese. refs

In some experiments axially compressive cylindrical shells with a large ratio of radius to thickness were observed to buckle with circumferential waves. The finite element method is utilized to study this buckling phenomenon. The bifurcation mode, as well as the axisymmetric one, is considered in the analysis as the mode of creep buckling. The number of circumferential waves obtained from the present analysis agrees well with that of other experiments. This implies that the circumferential waves observed in the creep buckling experiments are due to bifurcation.

Author

A92-32549

FINITE ELEMENT ANALYSIS OF CHANNEL WAVES IN LAMINATED MATERIALS

HIDEHITO OKUMURA and KUNIHICO OHTAKE (National Aerospace Laboratory, Chofu, Japan) *IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 1-11. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 1-O-1 to 1-O-8. refs*

This paper treats an analysis of a channel wave (guided wave) which is a higher order wave and propagates along layers of lower velocity in laminated materials. It is shown that a characteristic matrix for the Rayleigh-Lamb type waves can be obtained by the usual finite element formulation based on the principle of virtual work. Verifications of this formulation and a computer code are demonstrated using the problem of a semiinfinite medium with a surface layer. The channel wave propagating in multiple laminated materials is analyzed. The results

of the computational analysis for the Rayleigh type wave are in good agreement with the analytical values based on the Haskell method. From the results of the finite element analysis for a sandwich plate, it is found that stresses for the channel wave concentrate in the lower velocity region (i.e., the adhesive layer).

Author

A92-32562

AN ANALYSIS OF IMPACT RESISTANCE OF COMPOSITE BLADES FOR AIRCRAFT ENGINES (ANALYSIS WITH TWO DIMENSIONAL AND THREE DIMENSIONAL FINITE ELEMENTS)

TOSHIO MIYACHI, HIDEHITO OKUMURA, and KUNIIHIKO OHTAKE (National Aerospace Laboratory, Chofu, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 1-11. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 2-J-1 to 2-J-8. refs

The present impact-resistance feasibility FEM analysis for composite turbfan blades employs both plate elements and 3D elements, taking centrifugal loading effects into account. The impact response of six different fan-blade models was calculated. While the plate element models indicate a significant decrease of bending deformation by centrifugal force, torsional deformations and local deformations are not significantly reduced. It is found that the 3D-elements analysis for long, thin cantilever waves do not agree with experimental results.

O.C.

A92-32577

THE BUCKLING OF RECTANGULAR COMPOSITE PLATES WITH CUTOUT UNDER UNIAXIAL AND BIAxIAL COMPRESSION

YOSHIAKI YASUI (Tokai University, Hiratsuka, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 1-11. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 4-B-1 to 4-B-8. refs

FEM is presently used to explore the buckling strength of a simply-supported plate with centrally located circular cutout under uniaxial and biaxial loading. The buckling value for various cutout sizes, and buckled pattern modes for different plate aspect ratios, are obtained for carbon-reinforced epoxy and glass-reinforced epoxy composites. Angle-ply and cross-ply rectangular orthotropic plates are treated; in both types of laminations, the buckling value for increasing hole size appears higher than that for a plate without hole. The buckled wave of longer plates achieves higher-number modes as the delamination angle approaches the higher angles.

O.C.

A92-32583

FATIGUE AND IMPACT STRENGTH OF ARAMID/GLASS HYBRID LAMINATES FOR MARINE USE

ISAO KIMPARA, KAZURO KAGEYAMA, TOSHIO SUZUKI, ISAMU OHSAWA (Tokyo, University, Japan), and TOSHIMITSU OHGAMI (Toto, Ltd., Chigasaki, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 1-11. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 5-B-1 to 5-B-10. refs
(Contract MOESC-63420038)

A92-32586

FLEXURAL FRACTURE MECHANISM OF CARBON/ARAMID HYBRID UNIDIRECTIONAL FRP LAMINATES

MASAYUKI NAKADA, YASUSHI MIYANO, MEGUMU SUZUKI, and YOICHI HATTORI (Kanazawa Institute of Technology, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 1-11. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 5-E-1 to 5-E-9. refs

To investigate the flexural fracture behavior of carbon/aramid hybrid unidirectional FRP laminates (C/A hybrid FRP) in which the CFRP layer was sandwiched between two AFRP layers,

three-point bending tests for the C/A hybrid FRP as well as CFRP and AFRP were conducted at various constant temperatures. The flexural fracture behavior of the C/A hybrid FRP is classified into two modes by temperature. One is the compressive fracture of the CFRP layer in the high temperature range where the flexural strength decreases with temperature remarkably. The other is the tensile fracture of the AFRP layer in the range of low temperature where the flexural strength changes only slightly with temperature.

Author

A92-32661

FRACTURE MECHANISM OF GLASS CLOTH/EPOXY LAMINATES IN FRACTURE TOUGHNESS TESTS AT LIQUID NITROGEN TEMPERATURE

HIROYUKI KAWADA, TARO SATOH, TOMOHIRO TOYOOKA, and IKUHIKO HAYASHI (Waseda University, Tokyo, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 16-N-1 to 16-N-11. Research supported by Nippon Sheet Glass Foundation for Materials. refs

This paper presents a fracture mechanism of plain woven glass cloth/epoxy laminates in a compact tension (CT) specimen at liquid nitrogen temperature. Comparisons were also made between the CT specimens at 296 K and 77 K. The microfracture behaviors were investigated by surface observations in the vicinity of a notch root, using an optical microscope. It was found that the fracture toughness $J(\max)$ at 77 K was 3.3 times as large as one at 296 K, and that the former values varied widely. Tensile tests of the constituents of the GFRP revealed that these characteristics of the GFRP were primarily attributed to that of the glass fiber. Through the microscopic and fractographic observations, the growth processes of microcrackings in the matrix were clarified at each temperature. The fracture mechanism responsible for the increase of the fracture toughness of the GFRP specimen at 77 K is discussed.

Author

A92-32707

FATIGUE FRACTURE MECHANISM AT HIGH TEMPERATURE FOR SiC WHISKER REINFORCED A2024 MATRIX COMPOSITE

CHITOSHI MASUDA, YOSHIHISA TANAKA (National Research Institute for Metals, Tokyo, Japan), MOTOHIRO YAMAMOTO, and MINORU FUKAZAWA (Tokai Carbon Corp., Ltd., Fuji Institute, Shizuoka, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 20-G-1 to 20-G-12. refs

Fatigue properties and fracture mechanisms were examined for SiC whisker-reinforced A2024 matrix composite tested at 150 C and room temperature under the rotating bending condition. Fatigue strengths for specimens tested at 150 C and with up to 20 percent volume fraction of SiC whiskers increased with increasing the volume fraction. This fatigue strength was almost always lower than that for each volume fraction tested at room temperature. According to a 3D analysis of fatigue fracture surface of specimens tested at 150 C. Mode I fatigue crack is initiated by stage I type mechanism for SiCw/A2024 composite as well as for A2024 alloy. Fatigue crack propagated by striation mechanism in the whisker poor zones, while in the whisker rich zones crack was arrested. It is concluded that the role of SiC whisker is significant to mode I fatigue crack initiation and propagation at 150 C as well as at room temperature for the aluminum matrix composites.

Author

A92-32715

DYNAMIC SHEAR STRESS-STRAIN CHARACTERISTICS OF SiC WHISKER REINFORCED ALUMINUM ALLOY COMPOSITES

TAKASHI YOKOYAMA (Okayama University of Science, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991.

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Section 12-21. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 21-D-1 to 21-D-10. Research sponsored by Iketani Science and Technology Foundation. refs

Dynamic shear stress-strain characteristics of SiC whisker-reinforced 6061-T6 aluminum alloy composites are determined by means of a modified torsional split Hopkinson bar apparatus. A specially-designed thin-walled tubular specimen is used to eliminate the practical difficulties involved in attaching the specimen to the Hopkinson bars with an epoxy cement. The generation of a torsional loading pulse having a short rise-time is achieved through the sudden release of a torque stored in the portion of the incident bar. Reliable shear stress-strain data are presented at strain rates of over 1500/s for the SiCw/6061-T6 Al alloy composite and the matrix alloy. The experimental results show that the matrix Al alloy 6061-T6 itself is strain-rate independent over a range of strain rates in shear from $10 \exp^{-3}$ to about 1700/s, whereas the SiCw/6061-T6 Al alloy composite exhibits apparent strain-rate dependence. Author

A92-32762

INFLUENCE OF HYGROTHERMAL STRESSES ON TRANSVERSE CRACK TIP DELAMINATION

KYOHEI KONDO (Tokyo, University, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 27-D-1 to 27-D-12. refs

It is frequently observed that fracture of composite laminate under mechanical loading is caused by delamination at tips of transverse crack in the 90 deg ply due to the strain concentration in the adjacent plies. In the present paper, the influence of hygrothermal loading on delamination is investigated. Delamination at transverse crack tips in composite laminate subjected to the mechanical and hygrothermal loadings is characterized by the potential energy release rate associated with the delamination growth based on the fracture mechanics. Utilizing the superposition method, the mechanical and hygrothermal loadings are transformed to the mechanical loading applied to the transverse crack surface, and the potential energy release rate is obtained by classical lamination theory. The delamination onset strain of the graphite-epoxy composite laminate subjected to uniaxial mechanical loading together with the hygrothermal loading is predicted from the energy release rate, clarifying the influence of moisture and thermal residual stresses on the fracture of the laminate. Author

A92-32765

EFFECTS OF FIBER CONTENT ON FRACTURE MECHANISMS OF SHORT FIBER REINFORCED PET COMPOSITES

MEGUMU SUZUKI, SOTOAKI KIDA, MINORU SHIMBO, YASUSHI MIYANO, and SHIGERU MOROHASHI (Kanazawa Institute of Technology, Nonoichi, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 27-H-1 to 27-H-9. refs

Effects of fiber content by volume on fracture mechanisms of short glass fiber reinforced PET (FRPET) composites are investigated by measuring the tensile strength, the parameters showing the adhesion between the fiber and the resin, and the fiber orientation in the composite materials. The results are verified by means of a frequency analysis of AE signals and microfractography. It is found that the tensile strength of FRPET increases with an increase in the fiber content at a fiber content lower than 17.3 percent (30 wt pct) but the rate of increase in the tensile strength seems to decrease slightly with an increase in the fiber content at a fiber content higher than 17.3 percent, and that the damage modes are changed from the resin cracking and the fiber debonding and pulling out, to the fiber debonding and pulling out and fiber breakage at a content of 17.3 percent. Author

A92-32788

COMPRESSION AFTER IMPACT (CAI) PROPERTIES OF CF/PEEK(APC-2) AND CONVENTIONAL CF/EPOXY COMPOSITE STRUCTURES

TAKASHI ISHIKAWA, MASAMICHI MATSUSHIMA, YOICHI HAYASHI (National Aerospace Laboratory, Mitaka, Japan), and TATSURU NOGUCHI (Japan Aircraft Manufacturing Co., Ltd., Yokohama) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 28-S-1 to 28-S-10. Research supported by Science and Technology Agency of Japan. refs

Compression-after-impact (CAI) tests are conducted for quasi-isotropic thick plates of 48 plies and stiffened panel specimens made of CF/PEEK(APC-2) and conventional CF/epoxy composites. Delamination buckling is studied with a moire topography camera. An arresting of delamination propagation just before catastrophic failure due to high fracture toughness provides good CAI results for CF/PEEK. In CAI tests for stiffened panels, the effect of impact location is examined first. Impacts on skin carrying less axial loads do not degrade compressive strengths at all. Impacts on stiffeners provide considerable degradation of compressive strength. CF/PEEK panels exhibit higher CAI properties than CF/epoxy. However, the ratio of improvement is not as enhanced as that for thick plates because of the structural capacity for delamination arrest in stiffened panels. Author

A92-32789

COMPRESSIVE BEHAVIORS OF DELAMINATED COMPOSITE LAMINATES

HIROSHI SUEMASU (Sophia University, Tokyo, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 22-29. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 28-T-1 to 28-T-10. refs

Compressive properties of composite laminate decrease significantly due to the introduction of interlaminar delaminations. The delaminations are easily formed in the laminate when subjected to impact load, fatigue, etc., owing to its weak interlaminar toughness. Mechanisms of low compressive buckling load of composite laminate with multiple delaminations are studied analytically and experimentally. Rayleigh-Ritz approximation and finite element techniques are used in the analysis. The analytical results explain the experimental ones very well. The considerable loss of compressive strength is well explained by the assumption of multiple delaminations. Author

A92-32819

MICROSCOPIC STUDIES ON TEMPERATURE-DEPENDENT FAILURE PROCESS OF CONVENTIONAL AND TOUGHENED CROSS-PLY LAMINATES

A. KOBAYASHI, S. OGIHARA, and N. TAKEDA (Tokyo, University, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 31-A-1 to 31-A-12. refs

The temperature-dependent failure process of different cross-ply laminates, that is, (0/90(4)/0), (0/90(8)/0), and (0/90(12)/0), was investigated for both conventional-type T300/3601 and toughened-type T800/3631 carbon/epoxy composite systems. Tensile tests were performed both at 20 C and at 80 C. The temperature effects on the microscopic failure process and mechanism including first transverse cracking and multiple transverse cracking were discussed considering three dominant temperature-dependent factors that affect transverse cracking: transverse crack constraint effect, thermal residual stress in 90 deg ply, and fiber-matrix interfacial bond strength. In addition, the relationship between applied stress and transverse crack density was predicted by the distribution of the transverse strength of unidirectional composites. It was found that large decreases in

interface strength at 80 C affect the microscopic failure process.

Author

A92-32848

FLEXURAL-TORSION COUPLING VIBRATION OF FIBER COMPOSITE BEAMS

TAKEHITO FUKUDA, KIWAMI NAITO (Osaka City University, Japan), MITSUNORI MIKI, and YOSHIHIKO SUGIYAMA (Osaka Prefecture University, Sakai, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 34-A-1 to 34-A-10. refs

It is shown that the principal axis of elasticity (PAE) can be rotated from the structural axis by giving a specific fiber orientation or stacking sequence of a fiber composite beam. The theoretical results for PAE obtained by the use of the laminated plate theory agree with the experimental results for PAE of GFRP and CFRP laminated cantilever beams in the static flexural, torsional and flexural-torsion tests. It is illustrated by performing free vibration tests that even if a fiber composite beam has an eccentric mass, the torsional vibration can be prevented when PAE is made so as to go through the center of gravity by tailoring fiber orientations. The natural frequency of a beam is predicted by solving a simplified vibration equation of two degree-of-freedom system. Author

A92-32862

HIGH STRAIN RATE TENSILE PROPERTIES OF UNIDIRECTIONAL KFRP

KOZO KAWATA, MASAOKI ITABASHI, and SHINYA FUITSUKA (Tokyo, Science University, Noda, Japan) IN: Composites; Proceedings of the 8th International Conference on Composite Materials (ICCM/8), Honolulu, HI, July 15-19, 1991. Section 30-39. Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, p. 36-D-1 to 36-D-8. refs

High strain rate tensile properties of unidirectional KFRP in the strain rate range of 1000/s are successfully obtained by applying KHKK one bar method and newly designed long sheath adhesion type chucks certifying proper fracture of test piece in gage length without shear fracture in chucks liable to happen. The mechanical properties of unidirectional KFRP in 1000/s range do not show critical change comparing with the corresponding values in 0.001/s range. In contrast to KFRP, unidirectional GFRP shows remarkable increase of tensile strength and tensile breaking elongation with increasing strain rate. That is, it shows remarkable high velocity ductility. Author

A92-33128

INELASTIC DEFORMATION AND FATIGUE DAMAGE OF COMPOSITE UNDER MULTIAXIAL LOADING

S. MURAKAMI, Y. KANAGAWA, T. ISHIDA (Nagoya University, Japan), and E. TSUSHIMA (Tonen Corp., Corporate Research and Development Laboratory, Iruma, Japan) IN: Inelastic deformation of composite materials; Proceedings of the IUTAM Symposium, Troy, NY, May 29-June 1, 1990. New York, Springer-Verlag, 1991, p. 675-694. refs

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Inelastic deformation and damage process of graphite/epoxy laminate tubes under axial and combined axial and torsional loadings are discussed. Significant viscoplastic deformation is induced by axial loading due to matrix dominant deformation and fiber rotation. The negative stress ratios have marked effects on stiffness reduction, hysteresis curves, and fatigue life. These phenomena are attributable to the matrix dominant deformation of laminae and the accelerated viscoplastic deformation of polymer matrix under reversed loading. The fatigue strength is governed mainly by the maximum or minimum stress, and is influenced by the stress ratios. R.E.P.

A92-33131

VISCOELASTIC CREEP POST BUCKLING BEHAVIOR OF AS4/J1 THERMOPLASTIC-MATRIX COMPOSITE LAMINATES

Y. NAKAJO (Ashikaga Institute of Technology, Japan) IN: Inelastic

deformation of composite materials; Proceedings of the IUTAM Symposium, Troy, NY, May 29-June 1, 1990. New York, Springer-Verlag, 1991, p. 727-740. refs

Copyright

Above-critical behavior of AS4/J1 thermoplastic-matrix composite laminates at elevated temperature is examined taking time-dependence into consideration. The anisotropic time-temperature dependent viscoelastic constitutive equations of the composite are utilized to give mathematical expressions for compliances and Poisson's ratio for the analyses. The axial loads are assumed to be logarithmically linear functions of time as an example. The results obtained clarify the load carrying capability of the composite panels at elevated temperature in buckled conditions. In the case of angle ply, the degradation of load bearing capability with time is affected by the time-dependent shear modulus. R.E.P.

A92-33152

IMPACT WAVE AND STRESS

S. KIDA and H. KAKISHIMA (Kanazawa Institute of Technology, Japan) Experimental Techniques (ISSN 0732-8818), vol. 16, Mar.-Apr. 1992, p. 32-35. refs

Copyright

The axial impact of two rods of unequal cross-sectional area and dissimilar material has been experimentally and theoretically studied. The time history of the strain is measured using strain gages fixed on the curved surface from the impact end. The wave speeds and impact stresses of incidence, transmission, and reflection are calculated using this strain history. O.G.

A92-34069

STRESS BASED CRITERION FOR AN INTERFACE CRACK KINKING OUT OF THE INTERFACE IN DISSIMILAR MATERIALS

RYOJI YUUKI and JIN-QUAN XU (Tokyo, University, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 41, March 1992, p. 635-644. refs

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The fraction criteria on kinking of a crack out of the interface between two dissimilar isotropic elastic solids are studied. A new criterion is proposed, based on the maximum stress around an interface crack tip, which can be characterized by the SIFs for the interface crack before kinking. This criterion is quite similar to the mixed mode criterion for a homogeneous crack and therefore seems very convenient and useful. The kinking directions estimated by this criterion are compared with the results of He and Hutchinson (1989) and with some experimental data. C.D.

A92-34324#

APPLICATION OF LAMINATION PARAMETERS TO THE RELIABILITY-BASED STIFFNESS DESIGN OF FIBROUS LAMINATED COMPOSITES

MITSUNORI MIKI, YOSHISADA MUROTSU, NOBUHIKO MURAYAMA (Osaka Prefecture University, Sakai, Japan), and TETSUO TANAKA (Matsushita Electric Works, Ltd., Kadoma, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 463-470. refs

(AIAA PAPER 92-2350) Copyright

The lamination-parameter method is extended by means of a reliability analysis to develop a method for determining optimum laminate configurations with probabilistic stiffness constraints. The Advanced First-Order Second-Moment method is used to conduct the reliability analysis of the stiffness and strains of the laminates under probabilistic in-plane stresses. These data are used to optimize the fiber-orientation angles of the laminates, and a second reliability analysis is conducted for comparison against the deterministic conditions. A design region is identified on the lamination-parameter plane that describes the conditions of feasibility, and the region varies indirectly with the variation of material constants and the probability of meeting design constraints. The optimal lamination parameters can be developed for specific

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structural applications, and a method is also given that minimizes the variation in lamination parameters for the system when equivalent lamination parameters are available. C.C.S.

A92-34377#

APPROXIMATE SOLUTION ON THE ELASTIC CONTACT PROBLEMS BETWEEN TWO-LAYERED BODIES

JUHACHI ODA and TAKASHI KUBOTA (Kanazawa University, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 965-969. refs (AIAA PAPER 92-2531) Copyright

An approximate solution for the elastic contact problems between two-layered bodies is proposed. The two-layered body is an elastic body coated with a film. The approximate solution is analytically derived by applying the Hertzian contact theory and assuming stress field in the two-layered body. From the solution, the equations to obtain contact pressure distribution and contact width are derived in the closed form. As the numerical example, the elastic contact problem between a rigid cylinder and a two-layered elastic body, which is composed of an elastic film and a semi-infinite elastic body, is analyzed. From the results, the effectiveness of the present solution is examined by comparison with the Hertzian contact theory and the theoretical solution of Gupta and Walowit. Author

A92-34436#

OPTIMUM DESIGN OF CONTROL SYSTEM FOR LARGE DEGREES-OF-FREEDOM STRUCTURE TO ASSURE STABILITY AGAINST HIGH MODE VIBRATIONAL DISTURBANCE

I. KAJIWARA and A. NAGAMATSU (Tokyo Institute of Technology, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 3. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 1595-1603. refs (AIAA PAPER 92-2323) Copyright

Stability against such disturbances as high-mode vibration is presently ensured through the application of an optimum design method for small degrees-of-freedom (DOFs) control systems to a large-DOF structure modeled by FEM. A small model of n DOF (where n is less than the number of modes, p , whose stability must be ensured) is made by system identification with the frequency-control function. Attention is given to the illustrative case of a steel plate excited to as much as 1100 Hz, in which the nine natural modes included can be suppressed with a merely two-DOF control system on the basis of the present method. O.C.

A92-34533#

OPTIMUM TOPOLOGY AND SHAPE OF PLANE FRAMES WITH CONSTRAINTS OF STRESS, BUCKLING AND PROHIBITED SPACES FOR MEMBERS

KOICHIRO KAWASHIMA (Nagoya Institute of Technology, Japan), HIROSHI TSUTSUI (Aisin AW Co., Ltd., Anjo, Japan), MASATOMO KOJIMA (Brother Co., Ltd., Nagoya, Japan), and TOSHIHIRO ITO (Nagoya Institute of Technology, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 5. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 2508-2515. refs (AIAA PAPER 92-2251) Copyright

Simultaneous optimization of topology and the shape of the cross section of plane frames under constraints of stresses, displacements, global elastic buckling, and prohibited spaces for layout is solved with the FEM, sequential linear programming, and some rules of changing topology. The member is assumed to have uniform width but linearly varying thickness in the longitudinal direction and to carry axial force, shearing force, in-plane and out-of-plane bending moment, and torsion. The method presented here combines the 'ground structure approach' with some rules of changing topology. Thus, the optimization procedure is accelerated. Two examples of the preliminary structural design demonstrate the effectiveness of the present method. Author

A92-34537#

OPTIMUM DESIGN OF PLATE AND SHELL STRUCTURES USING THE VARIABLE THICKNESS ELEMENT

JUHACHI ODA, KOETSU YAMAZAKI, JIRO SAKAMOTO (Kanazawa University, Japan), and JUNPEI ABE (Suzuki Motor Corp., Hamamatsu, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 5. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 2545-2551. refs (AIAA PAPER 92-2312) Copyright

A new technique of optimum design for plate and shell structures is proposed. In this technique, the plate and shell structures are discretized into isoparametric finite shell elements, and the optimum design is implemented by considering nodal thicknesses as design variables and by using a mathematical programming method with design sensitivity analysis. The thickness distribution in each element is interpolated using the nodal values, so that the method can determine precise optimum design in which the thickness distribution are smooth, in spite of coarse finite-element subdivisions and less design variables. Minimum compliance design problems for a clamped plate and a motorcycle body constructed with plates are analyzed by using the proposed method. Author

A92-34559#

OPTIMAL LOCATIONS OF ACTUATORS FOR STATISTICAL STATIC SHAPE CONTROL OF LARGE SPACE STRUCTURE - A COMPARISON OF APPROACHES

JUNJIRO ONODA (Institute of Space and Astronautical Science, Sagami-hara, Japan) and YOJI HANAWA (Tokyo, University, Japan) IN: AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 33rd, Dallas, TX, Apr. 13-15, 1992, Technical Papers. Pt. 5. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 2788-2795. refs (AIAA PAPER 92-2558) Copyright

This paper compares the use of the genetic algorithm (GA) and an improved version of the simulated annealing (SA) method for the optimization of actuator placement for the static-distortion correction of trusses. The improved simulated annealing (ISA) method is reviewed which is essentially a combination of GA and SA. These approaches are used to solve typical design problems, and the results are compared to those from the exhaustive single-point substitution algorithm, the worst-out-best-in algorithm, and the SA algorithm. The optimal actuator placement problem involves the statistical static shape correction of a tetrahedral truss structure with three rings. The GA approaches and the ISA approach lead to better results than the other techniques and give groups of optimized solutions with good values for mean value and variance of the solutions. C.C.S.

A92-34776

DOUBLY-PERIODIC ARRAY AND ZIG-ZAG ARRAY OF CRACKS IN SOLIDS UNDER UNIAXIAL TENSION

M. ISIDA and H. IGAWA (Kurume Institute of Technology, Japan) International Journal of Fracture (ISSN 0376-9429), vol. 53, Feb. 1, 1992, p. 249-260. refs Copyright

The paper considers a doubly-periodic array and a zig-zag array of cracks in a 2D solid subjected to tension, as simplified models of randomly distributed cracks in materials. The analysis is based on the eigenfunction expansions of the complex stress potentials for properly chosen unit regions. Numerical results for the SIFs, crack opening displacements, and effects of cracks on the tensile stiffnesses of these solids are given for various combinations of the parameters. The results are then fitted to reliable polynomial formulas for convenience of engineering applications. Author

A92-34777

ON A TRANSIENT THERMAL STRESS PROBLEM IN AN INFINITE CIRCULAR CYLINDER WITH A PENNY-SHAPED CRACK

RYOHEI ISHIDA (Osaka Prefecture, University, Sakai, Japan)

International Journal of Fracture (ISSN 0376-9429), vol. 53, Feb. 1, 1992, p. 261-272. refs
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The SIFs under transient thermal loading in an infinitely long circular cylinder containing a penny-shaped crack are found. Variations of the SIFs with time, which are closely related to crack extension, are illustrated in the figures. Author

A92-35662#

ACTIVE, PASSIVE AND SEMI-ACTIVE VIBRATION SUPPRESSION BY STIFFNESS VARIATION

JUNJIRO ONODA (Institute of Space and Astronautical Science, Sagami-hara, Japan), TETSUJI SANO (Tokyo, University, Japan), and KOHICHI KAMIYAMA (Nihon University, Narashino, Japan) IN: AIAA Dynamics Specialists Conference, Dallas, TX, Apr. 16, 17, 1992, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 100-108. refs (AIAA PAPER 92-2090) Copyright

This paper investigates the vibration suppression by stiffness variation. First, optimal on-off control logic for SDOF variable-stiffness system is proposed. A control logic for MDOF system with multiple variable-stiffness element is also proposed. As an example of variable-stiffness system, a string whose tension is controllable is studied. Numerical simulation demonstrates the effectiveness of the proposed control logic. Next, a dry friction is shown to vary the tension of a string in the same way as this active control when the longitudinal stiffness is high, realizing a passive vibration suppression. The performance of the passive system is studied. To overcome the disadvantages of the passive system, a semi-active control is proposed, which controls the frictional force. Numerical simulations and an experiment demonstrate its effectiveness and robustness although it is primitive. Author

A92-36040

TWO-DIMENSIONAL THERMAL STRESS ANALYSIS OF BUTT ADHESIVE JOINTS

YUICHI NAKANO (Shonan Institute of Technology, Fujisawa, Japan), TOSHIYUKI SAWA (Yamanashi University, Kofu, Japan), and FUMITO NAKAGAWA (Tokyo Metropolitan College of Aeronautical Engineering, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, no. 2, April 1992, p. 145-151. refs

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The thermal stress distribution in an adhesive butt joint is analyzed in terms of two-dimensional elasticity. The effects of material and thermal properties and temperature distribution in the joint on the thermal stress distribution are determined numerically. The results obtained are compared with strain gauge measurements and results of a photoelastic experiment. It is found, in particular, that the thermal stress is tensile near the end of the adherend-adhesive interface and compressive near the center of the interface. V.L.

A92-36041

LOAD AND STRAIN HISTORIES FOR CFRP LAMINATES UNDER LOW-VELOCITY IMPACT

JOONG-SUK KOOK (Tokyo Institute of Technology, Japan), MASAYUKI SUZUKI (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Japan), TADAHARU ADACHI, SADAYUKI UJIHASHI, and HIROYUKI MATSUMOTO (Tokyo Institute of Technology, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, no. 2, April 1992, p. 159-164. refs

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The impulsive response of carbon fiber reinforced plastics (CFRP)-laminated plates are analyzed by using higher-order shear deformation theory and homogeneous anisotropic laminated plate theory. The plate of unidirectional prepregs is simply supported on all four sides and is hit by a spherical steel impactor at its center. The impact load histories are calculated numerically by using the nonlinear integral equation derived from Hertzian contact law. The strain histories of the plate are evaluated using higher-order theory and the numerical impact load histories

obtained above. The theoretical results are in good agreement with the experimental results obtained by strain gauges and a piezoelectric transducer. Author

A92-36042

STRESS ANALYSIS OF AN ORTHOTROPIC LAMINATED SLAB SUBJECTED TO TRANSVERSE LOAD

HIROYUKI MATSUMOTO (Tokyo Institute of Technology, Japan), YOSHIIHIDE OGAWA (Toyota Motor Corp., Ltd., Japan), and TADAHARU ADACHI (Tokyo Institute of Technology, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, no. 2, April 1992, p. 165-169. refs

Copyright
Stresses in a slab with three orthotropic laminated layers are analyzed by the 3D theory of transversely isotropic elasticity. The slab is subjected to transverse concentrated or distributed load at the center part on the top face. To obtain qualitative knowledge for delamination of carbon fiber reinforced plastic (CFRP) laminates, numerical results of interlaminar stresses are given for graphite/epoxy square laminates. It is shown that shear stresses on the upper interlaminar boundary are larger than those on the lower one. At each interlaminar boundary, shear stresses are maximal just below the concentrated load point or the edge of the distributed load area, although these stresses are zero at the center point. Author

A92-37100

COMPUTER MODELING OF THERMAL SHOCK-INDUCED CRACK GROWTH IN BRITTLE MATERIALS

S. SHIMAMURA and Y. SOTOIKE (Yamaguchi University, Ube, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, no. 5, May 1992, p. 1286-1291. Research supported by MOESC and Iketani Science and Technology Foundation. refs

Copyright
Crack morphology in brittle materials exposed to thermal shock is studied by means of Monte Carlo simulations based on simple three-dimensional lattice systems. Thermal shock-induced crack growth is modeled as a series of processes of storage, release, and transfer of strain energies in the system of grains. Special attention is devoted to the crack pattern on the surface exposed to thermal shock and the crack penetration in the direction perpendicular to the surface. The dependences of the crack pattern and the crack penetration on the grain boundary strength and the temperature difference of thermal shock are explored through the simulations. The results of the simulations are qualitatively consistent with crack features in available experimental reports. Author

A92-37522

BIFURCATION ANALYSIS OF SYMMETRIC STRUCTURES USING BLOCK-DIAGONALIZATION

KIYOHIRO IKEDA (Nagaoka University of Technology, Japan) and KAZUO MUROTA (Tokyo, University, Japan) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 86, no. 2, March 1991, p. 215-243. Research supported by Alexander von Humboldt-Stiftung. refs

Copyright
A group-theoretic method to trace bifurcation behavior of truss structures with regular-polygonal symmetry is proposed. By means of a suitable 'local' coordinate transformation, the present method decomposes the tangent-stiffness matrix into a block-diagonal form with possible occurrences of twice-repeated matrices. An efficient way to compute the block-diagonal form is described in view of the sparseness of the local transformation matrix. This achieves computational efficiency and moreover leads to systematic categorization of critical points. The present method is applied to a series of regular-polygonal truss domes to demonstrate its usefulness. Author

A92-37624

ANALYSIS OF ELASTIC-PLASTIC PROBLEMS BASED ON THE PRINCIPLE OF SUPERPOSITION. I - BASIC THEORY

DAI-HENG CHEN (Kyushu Institute of Technology, Iizuka, Japan)

39 STRUCTURAL MECHANICS

and HIRONOBU NISITANI (Kyushu University, Fukuoka, Japan) International Journal of Plasticity (ISSN 0749-6419), vol. 8, no. 1, 1992, p. 75-89. refs

Copyright

In this study, the body force method was extended to the analysis of elastic-plastic problems. It is shown that the stress fields caused by the plastic strains can be replaced by the stress fields due to force doublets. By using this fact a method for analyzing the elastic-plastic problems based on the principle of superposition is proposed. According to the method, the solution of an arbitrary problem is obtained by superposing the stress fields of the point forces and force doublets so as to satisfy a given boundary condition and the constitutive equation. The method of analysis was illustrated by taking as an example the elastic-plastic problem of an infinite plate with a circular hole subjected to internal pressure. Author

A92-38214

ADVANCED AEROSPACE STRUCTURES

HIROSHIGE KIKUKAWA (Fujitsu Heavy Industries, Ltd., Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 110-114. In Japanese. refs

Light structure technology for aircraft and spacecraft is presented. Cost reduction in the application of advanced composite materials are discussed and thermal protection systems, insulation and fasteners for the spaceplane are analyzed. Dimensional stability materials for deployable space structures and solar sail materials are emphasized. Y.P.Q.

A92-38405

A HYBRID OPTIMAL SYNTHESIS METHOD FOR TRUSS STRUCTURES CONSIDERING SHAPE, MATERIAL AND SIZING VARIABLES

SADAJI OHKUBO (Ehime University, Matsuyama, Japan) and KAZUHIRO ASAI (Sumitomo Heavy Industries, Ltd., Ehime, Japan) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-38401 15-64) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 34, no. 3, May 15, 1992, p. 839-851. refs

Copyright

A generalized hybrid optimal synthesis method is developed for truss structures in which the design variables are the co-ordinates of the panel points, cross-sectional areas and discrete material kinds of member elements. The primary design problem is formulated in terms of the shape, material and sizing variables and approximated to a sequence of convex and separable subproblems by using mixed direct/reciprocal design variables. Each subproblem is solved by a dual method in which the continuous shape and sizing variables are optimized by a Newton-type algorithm and the discrete material and continuous sizing variables are improved by a discrete sensitivity analysis. Using the proposed method, discrete material kinds, shape and sizing variables can be systematically improved to obtain an optimum solution. The rigourness, reliability and efficiency of the method are demonstrated by applying it to the minimum cost design of trusses subjected to stress and displacement constraints. Author

A92-38409

NUMERICAL INVESTIGATION OF ELEMENT-WISE A POSTERIORI ERROR ESTIMATION IN TWO AND THREE DIMENSIONAL ELASTIC PROBLEMS

HIDEOMI OHTSUBO (Tokyo, University, Japan) and MITSURU KITAMURA (Hiroshima University, Higashi-Hiroshima, Japan) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-38401 15-64) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 34, no. 3, May 15, 1992, p. 969-977. refs

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A systematic method of a posteriori error estimation in finite

element analysis of an arbitrarily shaped element is presented. Element-wise error analysis is proposed which is based on an isoparametric element with an interpolation function one order higher than that for the original stress analysis. It is concluded that stress solutions are significantly improved through adding the estimated error to the original finite element solutions. Using the results of a posteriori error analysis the original mesh is refined by the r-version and h-version of adaptive mesh generation techniques, which efficiently improves the accuracy of the finite element solution. O.G.

A92-39011

STABILIZED END NOTCHED FLEXURE TEST - CHARACTERIZATION OF MODE II INTERLAMINAR CRACK GROWTH

KAZURO KAGEYAMA (Tokyo, University, Japan), MASANORI KIKUCHI (Tokyo, Science University, Noda, Japan), and NOBORU YANAGISAWA (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: Composite materials: Fatigue and fracture. Vol. 3. Philadelphia, PA, American Society for Testing and Materials, 1991, p. 210-225. Research supported by Agency of Industrial Science and Technology of Japan. refs

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A stabilized end-notched flexure (ENF) test is proposed for experimental characterization of mode-II interlaminar crack growth. A special displacement gage is developed for direct measurement of crack-shear displacement (CSD) that is the relative shear slip between the upper and lower crack surfaces of the ENF specimen. The test is carried out under a constant CSD rate, ensuring that the crack growth is always stable. An analytical compliance method is applied successfully to the stabilized ENF test. Fracture toughness, G_{IIc} , and crack length are calculated from the load-vs-CSD diagram by using the analytical relationship between crack length and CSD compliance. A computer-aided testing system is developed for continuous measurement of the crack length and fracture toughness. Fracture behavior of a unidirectional carbon/epoxy laminate is examined during crack propagation as well as at the crack initiation by applying the proposed protocol. Author

A92-39256

SIMULTANEOUS OPTIMUM DESIGN OF STRUCTURAL AND CONTROL SYSTEM

TAKUZO IWATSUBO, SHOZO KAWAMURA, KAZUHIKO ADACHI, and MASAO IKEDA (Kobe University, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 117-140. refs

Copyright

Recently, the simultaneous optimum design of a structural and control systems has attracted special interest. This paper describes one approach to calculate the large number of elements of structure model in the simultaneous optimum design. To formulate the structural configuration, the gradients of the characteristic values and shape of the structure are taken as the structural design variables. In this way, the number of the structural design variables is constant in spite of the increase of number of elements. The locations of the sensors and actuators are taken as the control variables. These design variables are optimized under the condition of minimizing a objective function composed of the kinetic and control energies. Author

A92-39274

SOME APPROACHES TO THE OPTIMAL ADAPTIVE GEOMETRIES OF INTELLIGENT TRUSS STRUCTURES

YOSHISADA MUROTSU and SHAO WEN SHAO (Osaka Prefecture, University, Sakai, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 743-771. refs

Copyright

This paper is concerned with the optimal adaptive geometry of an intelligent truss structure subjected to a given external loading.

The optimal geometry is attained by changing the lengths of some active members to obtain the maximum structural strength. The study is carried out by using deterministic, probabilistic and dynamical approaches. The numerical results show that the structural strength is greatly increased by optimizing the geometry of the structure. Author

A92-39279**ACTIVE VIBRATION CONTROL OF A FREE-FREE BEAM BY USING A TENDON MECHANISM**

JUNJI TANI (Tohoku University, Sendai, Japan) and HIROKI UEDA (Mechanical Engineering Research Laboratory, Kobe, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 855-864. refs
Copyright

This paper is concerned with an active vibration control of a free-free beam. The beam is reduced to a finite-degree-of-freedom system by the modal analysis, in which the mode function is derived from the transfer matrix method. A control force is produced by a pair of tendons and a DC servo motor attached to the beam. The state of the beam is presumed by the minimum order state observer and the control force is determined by the digital optimum regulator theory. It is found that the active tendon control method is effective to suppress the vibration of the free-free beam. Author

A92-39300**AN APPROXIMATE METHOD FOR ANALYZING TAPERED MINDLIN PLATES**

H. MATSUDA, C. MORITA, and T. SAKIYAMA (Nagasaki, University, Japan) Computers & Structures (ISSN 0045-7949), vol. 43, no. 1, April 3, 1992, p. 185-191. refs
Copyright

An approximate method is developed to study the static bending of tapered Mindlin plates. The solutions are obtained by representing the partial differential equations into the ordinary differential equations by means of the Fourier series and by transforming the ordinary differential equations into integral equations and applying the numerical integrations. Some numerical examples are shown together with other analytical solutions, and as an application of this method, the results of tapered Mindlin plate are shown. Author

A92-39843**FRACTURE MECHANICS**

HIROYUKI OKAMURA, ED. (Tokyo, University, Japan) and KEIJI OGURA, ED. (Osaka University, Japan) London and New York, Elsevier Applied Science (Current Japanese Materials Research. Vol. 8), 1991, 290 p. For individual items see A92-39844 to A92-39851. (ISBN 1-85166-547-1) Copyright

Topics presented include the prediction of fracture toughness from small specimen tests, the effect of test conditions on the fracture toughness of fresh-water ice, fatigue crack growth at moderately elevated temperatures, and an analysis of surface cracks. Also presented are ductile fracture by void nucleation and growth in a process zone, acoustic emission source characterization, J-integral database for surface cracks, and the electric potential CT method for measuring 2D and 3D cracks. R.E.P.

A92-39844**STUDY OF FRACTURE FROM A NOTCH AND A CRACK BY THE LOCAL CRITERION APPROACH**

AKIO OTSUKA, TAKASHI MIYATA (Nagoya University, Japan), and KEIICHIRO TOHGO (Shizuoka University, Hamamatsu, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 19-42. refs
Copyright

Correlations between the cleavage fracture toughness and the yield stress and cleavage fracture stress for various steels were investigated on the basis of the incorporation of fracture criteria into the analytical solution of crack tip stress. Good

correlation according to the analytical prediction was obtained irrespective of the microstructure of the steels tested, and the possibility of a quantitative prediction of fracture toughness from a conventional round bar tensile test is shown. The continuum mechanics approach was examined for the ductile microvoid coalescence type of fracture from a notch and a crack. Numerical FEM analysis based on Gurson's constitutive equation for porous materials can well simulate the ductile fracture behavior from a notch, and the validity of the void volume fraction criterion for ductile crack initiation was confirmed. For a highly strain-concentrated region such as a crack tip, this criterion has a certain limitation in its applicability due to the scale problem of the fracture process. It is also shown that the steady state for the void volume fraction around the crack tip can be obtained as well as the stress and strain distributions. Author

A92-39847**ANALYSIS OF SURFACE CRACKS**

MASAKI SHIRATORI (Yokohama National University, Japan) and TOSHIRO MIYOSHI (Tokyo, University, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 145-170. refs
Copyright

A series of elastic and elastic-plastic analyses for surface cracks is reported. The methods used in these analyses are the influence function method, line spring method and supercomputing. A survey is presented of how these methods are effective in analyzing such complicated problems as those of surface cracks. Based upon these analyses, the extension of a fatigue crack or a ductile crack has been simulated and the condition of leak-before-break (LBB) for a surface-cracked body is discussed. Author

A92-39848**DUCTILE FRACTURE BY VOID NUCLEATION AND GROWTH IN A PROCESS ZONE**

HIROSHI MIYAMOTO and MASANORI KIKUCHI (Tokyo, Science University, Noda, Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 171-194. refs
(Contract MOESC-62302025)
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The mechanism for ductile fracture of Al-alloy 7075-T6 is studied by FEM analysis and experiments. A model for the interaction of a crack tip with a void or voids in its neighborhood is analyzed using the modified Gurson model. Taking the fracture criterion into consideration, an analysis of crack propagation is carried out. Experiments are also conducted on 1CT specimens, which are analyzed using fracture surface topography analysis (FRASTA), and the process of fracture is investigated in real time. Author

A92-39849**J-INTEGRAL DATABASE FOR SURFACE CRACKS**

GENKI YAGAWA, YASUMI KITAJIMA (Tokyo, University, Japan), and HIROYOSHI UEDA (Tokyo Electric Power Co., Inc., Japan) IN: Fracture mechanics. London and New York, Elsevier Applied Science, 1991, p. 195-215. refs
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The J-integral database for basic surface crack problems is obtained using the finite element method based on the theory of the fully plastic solution. To satisfy the incompressibility condition of a plastic material, two kinds of numerical techniques are employed. The local distributions and the global values of the J-integral are obtained for nine configurations of a semi-elliptical surface crack in a plate subjected to uniform tension, while the local J-integral distributions were analyzed for four configurations of a semi-elliptical surface crack in a plate subjected to bending. Author

A92-40581**VIBRATION OF TAPERED THICKNESS ANNULAR SECTOR PLATES BY SPLINE ELEMENT METHOD**

T. MIZUSAWA and K. TAKAMI (Daido Institute of Technology, Nagoya, Japan) Journal of Sound and Vibration (ISSN 0022-460X),

39 STRUCTURAL MECHANICS

vol. 154, no. 1, April 8, 1992, p. 147-160. refs
Copyright

This paper deals with the determination of the vibrations of thin annular sector plates of tapered thickness by using the spline element method. To demonstrate the accuracy of the present method, several examples are solved, and results are compared with those obtained by analytical methods and other numerical methods. Good accuracy is obtained. Frequencies of tapered annular sector plates with several boundary conditions are analyzed for the different sector angles and thickness parameters. Author

A92-40582 FREQUENCIES AND MODE SHAPES OF CANTILEVERED LAMINATED COMPOSITE PLATES

Y. NARITA (Hokkaido Institute of Technology, Sapporo, Japan) and A. W. LEISSA (Ohio State University, Columbus) Journal of Sound and Vibration (ISSN 0022-460X), vol. 154, no. 1, April 8, 1992, p. 161-172. refs
Copyright

This work presents an analytical approach and accurate numerical results for the free vibration of cantilevered, symmetrically laminated rectangular plates. The problem is solved by the Ritz method, and the natural frequencies are calculated for a wide range of parameters: e.g., composite material constants, fiber angles and stacking sequences. Extensive results are presented for angle-ply and cross-ply laminated plates. The results are compared to those in the existing literature, and the effects of varying the parameters upon the free vibration frequencies and mode shapes are discussed. Author

A92-41042 THREE-DIMENSIONAL ANALYSES OF INTERFACE CRACK FRONT FIELDS

S. AOKI (Tokyo Institute of Technology, Japan) and X. F. LUO (Tsinghua University, Beijing, People's Republic of China) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 42, no. 1, May 1992, p. 87-96. Research supported by Japan Society for the Promotion of Science and NNSFC. refs
Copyright

Three-dimensional finite element computation is performed for a through edge crack lying on an interface between an elastic-plastic material and a perfectly rigid substrate. The modified Gurson model suggested by Tvergaard and Needleman is used in the calculation. The distributions of stresses and microvoid volume fraction in an edge-cracked specimen subjected to a remote tensile stress are presented. It is found that the severe stress and void concentrations occur in the corner where the crack front runs into the free surface. The maximum microvoid volume fraction appears on the free surface when the remote stress is low, but appears inside the free surface at the higher remote stress. Author

A92-41785 STRESS ANALYSIS OF VARIABLE ADHESIVE THICKNESS AND VARIABLE ADHESIVE THICKNESS JOINTS

KENSUKE NONO (Kyushu Institute of Design, Kitakyushu, Japan), TOSHIO SUGIBAYASHI, KIYOMI MORI (Takushoku University, Hachioji, Japan), and HIROAKI ISONO (University of Industrial Technology, Sagamihara, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 69-72. In Japanese. refs

A model of adhesive thickness variations is presented. The shear stress distribution is evaluated, and results obtained using the proposed model are presented. Y.P.Q.

A92-41786 FRACTURE BEHAVIOR OF ADHESIVELY BONDED JOINTS AND SPOT WELDED JOINTS IN SHEET METAL JOINING

KIYOMI MORI, KATSURA FURUYA, TOSHIO SUGIBAYASHI (Takushoku University, Hachioji, Japan), and MITOSHI KAI (Koyogiken Corp., Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 73-76. In Japanese.

Experimental tests on spot welded joints in sheet metal joining are presented. The spot welded fracture stress is examined. Test results are analyzed. Y.P.Q.

A92-41787 QUANTITATIVE PREDICTION OF BONDLINE DURABILITY

HIROAKI YOSHIDA, YOHKO TANAKA, and KINJI TAKI (Shizuoka University, Japan) IN: Symposium on Adhesion and Adhesives, 29th, Nagoya, Japan, June 20, 21, 1991, Proceedings. Osaka, Adhesion Society of Japan, 1991, p. 77-80. In Japanese. refs

An experiment on the quantitative prediction of bondline durability is presented. The effects of bondline durability under varying temperature and humidity are discussed. The relationship between temperature and humidity variations is emphasized. Y.P.Q.

A92-41803 SOME IMPROVEMENTS OF ACCURACY AND EFFICIENCY IN THREE DIMENSIONAL DIRECT BOUNDARY ELEMENT METHOD

YIN-SHENG LI, TATSUO OBATA, HIDEO KOGUCHI, and TOSHIO YADA (Nagaoka University of Technology, Japan) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 33, no. 7, May 30, 1992, p. 1451-1464. refs
Copyright

A92-41833 BIFURCATION ANALYSIS FOR COUPLED FLUTTER-DIVERGENCE OF AN ASYMMETRIC DOUBLE PENDULUM SUBJECTED TO A FOLLOWER FORCE - CODIMENSION THREE PROBLEM

YUJI MATSUZAKI and TAKAYUKI NOMURA (Nagoya University, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, no. 106, Feb. 1992, p. 250-260. refs

Local bifurcations in the motion of a double pendulum subjected to a follower force have been studied when the follower force and the springs at the joints have structural asymmetries. The bifurcations of the system are examined in the neighborhood of a coupled flutter-divergence singularity, that is, a zero eigenvalue and a pure imaginary pair. Applying the center manifold and the normal form theorem to a 4D governing equation, a 2D equation with three unfolding parameters, which consists of a codimension three bifurcation problem is obtained. All the local bifurcation boundaries can be obtained for the criterion for the pitchfork bifurcation. The effect of the structural asymmetry on the bifurcation boundaries has been examined comparing with previous results about the symmetrical pendulum-follower force system. Numerical simulation was performed to confirm the analytical prediction. Author

A92-43083 STRESS INTENSITY FACTORS AT TIPS OF BRANCHED CRACKS UNDER VARIOUS LOADINGS

M. ISIDA (Kurume Institute of Technology, Japan) and H. NOGUCHI (Kyushu University, Fukuoka, Japan) International Journal of Fracture (ISSN 0376-9429), vol. 54, no. 4, April 15, 1992, p. 293-316. refs

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Several papers have been published on branched cracks by using various analytical methods, but most of them are concerned with special crack geometries or special loading conditions, and often give unreliable values for cracks with short branches or with small branching angles. The purpose of this paper is to give reliable formulas and new results of the stress intensity factors of various branched cracks in a wide plate. The analysis is based on the body force method combined with a perturbation procedure, and the stress intensity factors at the tips of all the branches and the main crack are given by power series formulas. Numerical results for typical branched cracks are discussed. Author

A92-43106

COALESCENCE CRITERIA FOR COPLANAR MULTIPLE SURFACE CRACKS

TOSHIHIKO NISHIMURA (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan) and MIKIO SASAJIMA (Japan Aircraft Development Corp., Tokyo) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 72-75. Research supported by Japan Aircraft Development Corp. refs

New criteria are proposed to predict the coalescence for coplanar multiple surface cracks under uniform tensile loading. The coalescence is assumed to occur when the internal plastic zones between cracks are attached, or the brittle fracture condition is satisfied. The plastic zone sizes for the coplanar surface cracks are approximated using the Dugdale solution for the coplanar through cracks by empirically modifying the effect of the three-dimensional profile. The stress intensity factor of the multiple surface cracks is calculated based upon the Newman-Raju equation by multiplying the finite width and mutual interaction factors. The applicability of the proposed criteria is verified by correlating with the constant amplitude fatigue growth data. It is shown that the proposed coalescence criteria are superior to the ASME design rule. Author

A92-43107

SOME CONSIDERATION FOR EVALUATION OF STRUCTURAL INTEGRITY OF AGING AIRCRAFT

HIROYUKI TERADA and HIROO ASADA (National Aerospace Laboratory, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 76-79. refs

The objective of this paper is to examine the achievement and the limitation of state-of-the-art of the methodology of damage tolerant design and the subjects to be solved for further improvement. The topics discussed are: the basic concept of full-scale fatigue testing, fracture mechanics applications, repair of detected damages, inspection technology, and determination of inspection intervals, reliability assessment for practical application, and the importance of various kinds of data acquisition. Author

A92-43133

OPTIMUM STRUCTURAL DESIGN OF A CANTILEVERED RECTANGULAR ELASTIC WING WITH A GUST LOAD ALLEVIATION SYSTEM

SHINJI SUZUKI and YONEZAWA SATOSHI (Tokyo, University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 180-183. In Japanese. refs

Equations for the optimum structural design of a cantilevered rectangular wing are presented. The Liapunov method is applied and the targets of the optimization are discussed. The structural optimization is analyzed. Y.P.Q.

A92-43238

STUDY ON A THREE-DIMENSIONAL REINFORCED TRUSS JOINT

HIROSHI HATTA, TAKAKO TAKEI, and T. SUGANO (Mitsubishi Electric Corp., Sagamiara, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 616-619. In Japanese.

A truss joint made of carbon fiber reinforced plastics (CFRP) for space platforms and large satellites are presented. Reinforced materials for the joints are discussed, and joint characteristics are described. The forming process of the joint and the compression testing method are described. Y.P.Q.

A92-44266

SINGULAR STRESSES AT THE TIPS OF A CRACK TERMINATING AT THE INTERFACE OF TWO BONDED ANISOTROPIC MEDIA SUBJECTED TO LONGITUDINAL SHEAR LOADING

TOSHIMI KONDO (Nagaoka College of Technology, Japan)

Engineering Fracture Mechanics (ISSN 0013-7944), vol. 42, no. 3, June 1992, p. 445-451. refs

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The problem of a crack terminating with an arbitrary angle at the interface of two bonded anisotropic media subjected to longitudinal shear loading is considered. By using the singular point method, a singular integral equation with the generalized Cauchy kernel is derived and the singular stress fields of the crack tips are determined. The influences of anisotropy of the media and crack angles on the stress intensity factors are clarified graphically. Author

A92-44415

STRESS INTENSITY FACTORS OF CRACKS INITIATING FROM A RHOMBIC HOLE DUE TO UNIFORM HEAT FLUX

NORIO HASEBE (Nagoya Institute of Technology, Japan), HIDEAKI IRIKURA (Kashima Construction Co., Tokyo, Japan), and TAKUJI NAKAMURA (Nagoya Institute of Technology, Japan) Engineering Fracture Mechanics (ISSN 0013-7944), vol. 42, no. 2, May 1992, p. 331-337. refs

Copyright

Analyses of heat flux, thermal stress, and temperature are conducted for an infinite plate with symmetric cracks initiating from a rhombic hole. The stress intensity factors and singularity of the heat flux at the crack tip are derived. The dislocation method and the rational mapping function are employed for these analyses. R.E.P.

A92-44687

THE STRESS FIELDS CAUSED BY A CIRCULAR CYLINDRICAL INCLUSION

HISAO HASEGAWA (Meiji University, Kawasaki, Japan), VEN-GEN LEE, and TOSHIO MURA (Northwestern University, Evanston, IL) ASME, Transactions, Journal of Applied Mechanics (ISSN 0021-8936), vol. 59, no. 2, pt. 2, June 1992, p. S107-S114. refs (Contract DAAL03-89-K-0019)

(ASME PAPER 91-WA/APM-32) Copyright

Exact solutions are presented in closed forms for the axisymmetric stress and displacement fields caused by a solid or hollow circular cylindrical inclusion (with uniform axial eigenstrain prescribed) in an infinite elastic solid. The same expressions are obtained for the elastic fields for interior and exterior points of the inclusion. Although Eshelby's solutions for ellipsoidal inclusions are uniform in the interior points, the present solutions do not show the uniformity. When the length of inclusion becomes infinite, the present solutions agree with Eshelby's results. The strain energy is also shown. The method of Green's function is used. Author

A92-45403

PRELIMINARY STUDY OF ALGORITHM FOR REAL-TIME FLUTTER MONITORING

KATSUHIKO SHIBATA and KATSUYA MATSUZAKI (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Works, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 325-330. refs

(SAE PAPER 912001) Copyright

This paper describes an algorithm for real-time flutter monitoring. An autoregressive (AR) model with time-varying coefficients is used for continuous monitoring of the nonstationary flutter parameters. AR coefficient change rates as well as AR coefficients can be obtained recursively by Kalman filter implementation. Using these AR coefficients and change rates, the natural frequencies and damping values of vibration modes can be estimated and predicted a few seconds ahead. This algorithm was tested on simulated data and wind tunnel test data and showed a good estimation performance. Author

A92-47207

COMPARISON OF ENERGY ABSORPTION OF CARBON/EPOXY AND CARBON/PEEK COMPOSITE TUBES

H. HAMADA (Kyoto Institute of Technology, Japan), J. C.

39 STRUCTURAL MECHANICS

COPPOLA, D. HULL (Cambridge, University, England), Z. MAEKAWA (Kyoto Institute of Technology, Japan), and H. SATO (Yokohama Rubber Co., Ltd., Hiratsaka, Japan) Composites (ISSN 0010-4361), vol. 23, no. 4, July 1992, p. 245-252. Research supported by Ford Motor Co. refs
Copyright

Axial compressive tests have been carried out on carbon fiber/epoxy and carbon fiber/PEEK tubes made from unidirectional prepreg materials. Three fiber architectures were investigated: unidirectional fibers parallel (0 deg) to the axis of the tube, +/- 30 deg, and +/- 45 deg. One set of tubes was machined with a 45-deg chamfer at one end in an attempt to trigger progressive crushing, and the other set had square ends to determine the compressive strength of the material. Stable progressive crushing occurred in +/- 45 deg carbon fiber/epoxy tubes and 0-deg carbon fiber/PEEK tubes where the crush stress was significantly lower than the compressive fracture strength. The 0-deg carbon fiber/PEEK tubes had a specific energy absorption of 180 kJ/kg, which is the highest value recorded for any material. This high value is interpreted in terms of the high interlaminar toughness of PEEK-matrix composites. Author

A92-47277 ANALYSES OF ELASTIC-PLASTIC PROBLEMS BASED ON THE PRINCIPLE OF SUPERPOSITION. II - ELASTIC-PLASTIC ANALYSIS OF AN INFINITE PLATE WITH AN ELLIPTIC HOLE OR A CRACK

DAI-HENG CHEN (Kyushu Institute of Technology, Izuka, Japan) and HIRONOBU NISITANI (Kyushu University, Fukuoka, Japan) International Journal of Plasticity (ISSN 0749-6419), vol. 8, no. 3, 1992, p. 245-269. refs
Copyright

This article is concerned with the elastic-plastic analysis of an infinite plate with an elliptic hole or a crack. The method of analysis is the body force method extended to the elastic-plastic problems. In this method, the solutions are obtained by superposing the elastic fields due to the force doublets acting in an infinite plate with an elliptic hole or a crack, so as to satisfy the constitutive equation of plasticity. The elastic-plastic behaviors near a notch root or a crack tip are discussed from the viewpoint of the linear notch mechanics. Author

A92-47298 FRACTURE BEHAVIOR OF NOTCHED SHEET-MOLDING-COMPOUND COMPOSITES

SATOSHI NAGOH, NAK-SAM CHOI, and KIYOSHI TAKAHASHI (Kyushu University, Kasuga, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 464, May 1992, p. 700-706. In Japanese. refs
Copyright

The effect of notched tip radius on the fracture behavior of compact tension type specimens of sheet-molding compound composites was studied. For specimens were rho of 0.56 or less, a main crack initiated at the notch tip and grew in parallel with the generation of many subcracks surrounding the main crack tip. For rho of 2.1 mm, subcracks propagated in radial directions during main crack growth. With increasing notch tip radius, little increase in the maximum load, acoustic emission (AE) cumulative event count, and standard deviations of AE source locations was observed. C.D.

A92-47588 ACTIVE WAVE CONTROL OF A FLEXIBLE BEAM (FUNDAMENTAL CHARACTERISTICS OF AN ACTIVE-SINK SYSTEM AND ITS VERIFICATION)

NOBUO TANAKA and YOSHIHIRO KIKUSHIMA (Mechanical Engineering Laboratory, Tsukuba, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, no. 2, June 1992, p. 236-244. refs
Copyright

This paper deals with the active wave control of a flexible beam. It is the purpose of this paper to realize experimentally the active sink proposed in the previous paper, and to discuss the

fundamental characteristics of the active-sink system. First, for the purpose of observing wave flow traveling along the beam, a visualization system is developed. Next, on the basis of the visualization system an experiment is carried out to verify the existence of the active sink. Then, from an analytical point of view, this paper further investigates the characteristics of the active-sink system, showing that an active source also exists in addition to the active sink. It is also found that there are two suppression patterns in active wave control; that is, the progressive-wave type and the standing-wave type. Finally, by introducing both phase distribution and gain of the complex reflection coefficient over a flexible beam, the generation mechanism of these patterns is clarified. Author

A92-47590 DECOMPOSITION METHOD FOR MODE SHAPE IDENTIFICATION USING MEASURED DATA

YOSHITSUGU YASUI (NTT, Radio Communication Systems Laboratories, Yokosuka, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, no. 2, June 1992, p. 279-285. refs
Copyright

A mode shape identification procedure which yields mass-weighted orthogonal modes is proposed for application to a vibration test. The orthogonalization is accomplished by eliminating errors existing in the combination of measured forced response equations and an assumed mass matrix. A matrix decomposition technique is utilized for extracting the error coefficients, by which the modification of measured data is performed subject to the theoretical constraints of the forced response equation. The procedure presented herein is formulated for a base excitation test and demonstrated numerically in evaluating the mode participation factors of a component model using a simple plate model. The identified parameters are in good agreement with the exact values, and also, the identified mode shapes satisfy the orthogonality requirement. A comparison with Targoff's method and an evaluation using simulated measurement data with random errors are also presented. Author

A92-47761 THERMAL DEFORMATION OF A LARGE SPACE PANEL CAUSED BY TEMPERATURE DIFFERENCE BETWEEN FRONT AND REAR SIDES

NAOKI ICHIKAWA, HARUHISA KUROKAWA, NOBUYUKI YAJIMA, SHIGERU KOKAJI, and AKIO SUZUKI (Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 461, 1992, p. 346-353. In Japanese. refs

This paper describes the development of a ground test system for determining the thermal deformation of large antenna panels to be used in space. The system is designed to measure the deformation occurring as a result of temperature differences between the front and rear surfaces of the panel. In the experimental set-up, a symmetric honeycomb panel was used. The front surface of the panel was heated by IR radiation, and the deformation was determined using a fringe scanning moire system which measured the shape of the rear surface. It was found that the temperature difference realized by the system was of the same order as was estimated on the orbit. The variations in the temperature difference were less than 15 percent of the average value. The effects of temperature distribution on the deformation were evaluated to be negligible by an FEM calculation. Author

A92-49250 VIBRATION OF BEAMS WITH VARYING CROSS-SECTIONS BY THE STODOLA-NEWMARK METHOD

N. NAKAHIRA, K. OZAWA (Katayama Iron Works, Ltd., Osaka, Japan), and T. MIZUSAWA (Daido Institute of Technology, Nagoya, Japan) Computers and Structures (ISSN 0045-7949), vol. 43, no. 5, June 3, 1992, p. 999-1004. refs
Copyright

This paper deals with the vibration of beams with varying cross-sections using the Stodola-Newmark method which is an alternative discrete-approach to solve directly the governing

ordinary differential equation. To demonstrate the convergence and accuracy of the present method, several examples are calculated and are compared with those obtained by the analytical methods and other numerical methods. The present results converge to the exact values with the increment of panels which are similar to mesh divisions. The frequencies of cantilever beams with arbitrarily varying cross-sections such as tapered, parabolic or cubic breadth and depth in air or in water are analyzed.

Author

A92-49343

DEFORMATION AND STRENGTH OF STEPPED-LAP JOINTS BONDED WITH ADHESIVE RESIN

K. MORI and T. SUGIBAYASHI (Takushoku University, Tatemachi, Japan) Journal of Strain Analysis for Engineering Design (ISSN 0309-3247), vol. 27, no. 3, July 1992, p. 171-175. refs

Copyright

Deformation and strength of stepped-lap bonded joints under static tensile loading are investigated both analytically and experimentally. The joints used in this study consist of the same metal adherends of carbon steel and an adhesive of epoxy resin. The effects of the overlap length and number of steps on the joint strength are studied. The joint strength is predicted by applying the strength criteria on the adherends, the adhesive and their interfaces in the joint. The predicted results agree fairly well with the experimental initial cracking strengths. The experimental final fracture strengths of the joints increase with the overlap length and with the number of steps.

Author

A92-49785

AN ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS OF A BLUNTING INTERFACE CRACK WITH MICROVOID DAMAGE

SHIGERU AOKI, KIKUO KISHIMOTO (Tokyo Institute of Technology, Japan), and NORIYASU TAKEUCHI (Ricoh Co., Ltd., Imaging Technology Research Center, Tokyo, Japan) International Journal of Fracture (ISSN 0376-9429), vol. 55, no. 4, June 15, 1992, p. 363-374. Research supported by MOESC and Martin Marietta Energy Systems, Inc. refs

Copyright

A finite strain elastic-plastic finite element analysis is performed on a crack which lies on an interface between two dissimilar materials. The materials above and below the interface are assumed to be different from each other in yield stress or in strain-hardening exponent. Gurson's constitutive equation for porous plastic materials is used in order to take into account the effect of the microvoid nucleation and growth on the fields near the tip of a crack. It is found that the microvoids have larger effects on the crack tip blunting and stress fields for a bimaterial than for a homogeneous material. It is also found that the plastic strain and the microvoid volume fraction localize in a few narrow bands which grow into the softer material from the intersection of the interface and the blunted crack tip at inclinations of about 15 deg to 45 deg.

Author

A92-50124

DETERMINATION OF THE COMPLEX SHEAR MODULUS OF DAMPING MATERIALS BY THE COMPOSITE BEAM TEST METHOD

HIROMI DEWA (Ibaraki University, Hitachi, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 35, no. 3, July 1992, p. 340-346. refs

Copyright

A method for determining the complex shear modulus of damping materials is proposed which is based on torsional resonant testing of a covered and sandwich specimen. The dynamic shear modulus and the loss factor of the damping rubber are determined for a covered specimen with varying temperature.

O.G.

A92-50333

OPTIMAL SHAPE DESIGN OF LATTICE STRUCTURES FOR ACCURACY

HIROSHI FURUYA (Nagoya University, Japan) AIAA Journal

(ISSN 0001-1452), vol. 30, no. 9, Sept. 1992, p. 2357-2359. refs
Copyright

The optimal configuration of lattice space structures, taking into account statistical sensitivity to shape distortions of the structures due to random member length errors, is presented. Results of the 2D truss masts have been demonstrated to predict the effective members contributing to the errors. Characteristics of the optimal configuration are also investigated.

R.E.P.

A92-51390

VARIATIONS OF STRAIN AND STRESS IN THE VICINITY OF CRACK TIP DUE TO CRACK CLOSURE AND MEASUREMENT OF CRACK CLOSURE POINTS

CHOBIN MAKABE, HIDEO KANESHIRO (University of the Ryukyus, Okinawa, Japan), and SHIN-ICHI NISHIDA (Saga University, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 849-854. In Japanese. refs

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The local stress and strain in the vicinity of crack tip were calculated by means of a finite element method to examine the measuring method of crack closure points. The fatigue crack closure behavior affected the local stress $\sigma(x)$ of cracking direction much more than the local stress $\sigma(y)$ of loading direction in the vicinity of crack tip. The diagram between the nominal stress σ representing cyclic loading and $\sigma(x)$ had some inflection points. One of them coincided well with the crack opening point. However, some undesirable inflection points due to plastic constraint or crack blunting were also found on the σ - $\sigma(x)$ diagram. On the other hand, the diagram between σ and the local shear stress in the vicinity of crack tip was found to have clear inflection points related to the crack closure behavior.

Author

A92-51391

ELASTIC-PLASTIC ANALYSIS ON THE GROWTH OF AN INTERFACIAL CRACK

SHIGERU AOKI (Tokyo Institute of Technology, Japan) and XUE-FU LUO (Tsinghua University, Beijing, People's Republic of China) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 887-891. In Japanese. refs

Copyright

An elastic-plastic finite element simulation of the growth of a crack on an interface between dissimilar materials was carried out, assuming the small-scale yielding condition and large bonding strength of the interface. Results showed that the value of J-integral at crack initiation for an interfacial crack is much lower than that for a crack in a homogeneous material. It was also found that the interfacial crack grows in the softer material near the interface, leaving a bit of the material adhering to the interface.

I.S.

A92-51394

MEASUREMENT OF FATIGUE CRACK OPENING AND CLOSING POINTS IN THIN PLATE SPECIMEN AND ITS DIFFICULTIES

CHOBIN MAKABE, HIDEO KANESHIRO (University of the Ryukyus, Okinawa, Japan), SHIN-ICHI NISHIDA (Saga University, Japan), and TATEKI YAFUSO (University of the Ryukyus, Okinawa, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 41, no. 465, June 1992, p. 951-956. In Japanese. refs

Copyright

Results are presented of measurements of the crack opening and closing points in a center-notched thin plate, carried out using an unloading elastic compliance method and a strain interference method. Strain measurements were carried out at several positions around the notch and the crack. The application of these methods to actual machine equipment is discussed.

I.S.

A92-53005

PROPAGATION OF ELASTIC/VISCOPLASTIC WAVES IN A CIRCULAR CYLINDER SUBJECTED TO TORSIONAL IMPACT

39 STRUCTURAL MECHANICS

KAISHIN LIU and TAKASHI YOKOYAMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 463, 1992, p. 431-436. In Japanese. refs

Two-dimensional solutions are presented for the propagation of torsional waves in an elastic/viscoplastic circular cylinder subjected to a dynamically applied shear stress with nonlinear radial variation at its end surface. The equations governing the dynamic torsional deformation of the cylinder are solved by using the method of numerical integration along bicharacteristics. The distributions of the dynamic shear stresses in the vicinity of the impact end of the circular cylinder are studied to determine the limitations of the elementary theory of torsional wave propagation. The numerical results for the torsional elastic waves in the circular cylinder are shown to be in good agreement with the existing exact solutions. Author

A92-53008

DEFLECTION OF A MEMBRANE STRIP SUBJECTED TO PRESSURE AND GRAVITY FORCES

SUMIO KATO and MICHIOHITO NATORI Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 463, 1992, p. 453-463. In Japanese. refs

The reflecting surface of an inflatable reflector for space utilization is made up of one or several inflatable elements (membrane elements), which are pressurized to produce an accurate reflecting surface. The deflection and the surface accuracy of an inflatable element subjected to pressure and gravity loadings are analyzed based on a flexible-membrane strip model whose initial configuration is straight or an arc, with both ends immovably supported. The effect of gravity on the surface error is found to increase as the ratio of gravity to pressure and the strip center height increase, and as the rigidity (Young's modulus) decreases. L.M.

A92-53225

VIBRATION OF ANNULAR SECTOR PLATES USING SPLINE STRIP METHOD

TOMISAKU MIZUSAWA (Daido Institute of Technology, Nagoya, Japan) and TATEO KAJITA (Matsusaka University, Japan) Communications in Applied Numerical Methods (ISSN 0748-8025), vol. 8, no. 8, Aug. 1992, p. 537-546. refs
Copyright

This paper presents the vibrations of annular sectorial plates with two opposite radial edges simply supported using the spline strip method. To demonstrate the convergence and accuracy of the present method, several examples are solved, and results are compared with those obtained by the analytical method and by other numerical methods. Stable convergence and excellent accuracy are obtained using the high-order spline strip models. Accurate frequencies of annular sector plates with different sector angles, radii ratios and tapered thickness in the angular direction are shown in tabular form. Author

A92-53304

AN ALTERNATIVE CORRELATING PARAMETER FOR CREEP CRACK GROWTH RATE AND ITS APPLICATION - DERIVATION OF THE PARAMETER Q^*

A. T. YOKOBORI, JR. (Tohoku University, Sendai, Japan), TAKEO YOKOBORI (Teikyo University, Utsunomiya, Japan), TETSUO NISHIHARA (Nuclear Research Institute, Chiba, Japan), and TOSHIKI YAMAOKA (Mitsubishi Heavy Industries, Ltd., Mihara, Japan) Materials at High Temperatures (ISSN 0960-3409), vol. 10, no. 2, May 1992, p. 108-118. Research supported by MOESC and Science and Technology Agency of Japan. refs
Copyright

The parameter Q^* has been proposed for correlating or characterizing creep crack growth rate. The creep crack growth rate has been expressed in terms of an activation process equation, and the parameter Q^* was defined as the exponent of the exponential in the thermal activation process equation for the da/dt , in which the activation energy is expressed in terms of free energy. CrMoV steel was used for VAMAS round-robin tests, and other materials such as SUS 304 and the Ni-base alloy of Hastelloy-XR

were used. For these materials good correlations are obtained. An analytical conclusion about the effect of thickness on crack growth is described. Author

A92-53522

FORMULA FOR ESTIMATING THE FUNDAMENTAL PERIOD OF CANTILEVER CYLINDRICAL SHELLS WITH INTERNAL LIQUID

YASUHIKO SASAKI, JIN YOSHIMURA, and TAKASHI MIKAMI (Hokkaido University, Sapporo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 527-531. refs
Copyright

This paper presents a simple practical formula for estimating the fundamental period of liquid-filled cantilever cylindrical shells in beam-type motion. The formula is obtained by using Dunkerley's approximation. A comparison with other solutions suggests that the proposed formula presented provides satisfactory accuracy for a wide range of shells. In addition, the formula is useful not only for a better understanding of the vibration characteristics of the shell but also available for a check on other numerical methods. Author

A92-53524

FREE VIBRATION OF SHELLS OF REVOLUTION PARTIALLY FILLED WITH LIQUID BY THE COLLOCATION METHOD

JIN YOSHIMURA and TAKASHI MIKAMI (Hokkaido University, Sapporo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, AGNE Publishing, Inc., 1990, p. 545-550. refs

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This paper presents a simple and effective solution procedure, based on the collocation method, for the free vibration of shells of revolution with internal liquid. The versatility and accuracy are illustrated through several numerical examples. The method appears to be easy to formulate and simple to use. Author

A92-53784

STRESS DISTRIBUTION AROUND A CRACK IN DISSIMILAR MEDIA

KOJIRO ENDO (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2343-2348. refs
Copyright

The generalized plane deformation problem for two bonded fiber-reinforced laminae with arbitrary fiber orientation is considered. It is assumed that the media contain a crack on the interface and that the crack is fully opened. Utilizing the Fourier transformation, the formulation leads to three coupled singular integral equations, which are solved in a closed form with the Jacobi polynomials. The solution has complex singularities, and this results in the oscillatory stress singularities and the overlapping of the crack surfaces. The strain energy release rates are computed numerically with the virtual crack closure integrals. Numerical examples for a crack in theta/-theta graphite-epoxy composites show that the overlapping cannot be disregarded for the case of shear mode loading. For tensile mode loading only, it is not observed except near crack tips. Author

A92-54260

NONLINEAR STRESS AND DISPLACEMENT ANALYSIS OF RIGID PLANE FRAMES BY TOTAL COMPLEMENTARY ENERGY MINIMIZATION

S. OHKUBO (Ehime University, Matsuyama, Japan) and K. MAKINO (Kan-onji City Office, Kagawa, Japan) (WCCM II - World Congress of Computational Mechanics, 2nd, Universitaet Stuttgart, Germany, Aug. 27-31, 1990, Selected Papers. A92-54242 23-39) Computers & Structures (ISSN 0045-7949), vol. 44, no. 1-2, July 3, 1992, p. 193-206. Research supported by MOESC. refs
Copyright

Methods for stress and displacement analysis of rigid plane frames subjected to material nonlinearities are proposed on the basis of the principle of minimum complementary energy, the Crotti-Engesser theorem, and mathematical programming techniques. The stress analysis problem is formulated as a minimization of the total complementary energy subject to the equilibrium equations at the free nodes. The unknown member end forces are determined by solving the energy minimization problem using a modified sequential quadratic programming and linear programming algorithms. The problem formulation and analysis algorithms of the proposed methods are applicable to rigid frame structures with any type of material nonlinearity. The accuracy and efficiency of the proposed methods are demonstrated by comparing their results with those of the displacement method of analysis for several statically indeterminate rigid frame structures with three types of material nonlinearities. Author

A92-54267

THE COLLOCATION METHOD FOR ANALYZING FREE VIBRATION OF SHELLS OF REVOLUTION WITH EITHER INTERNAL OR EXTERNAL FLUIDS

T. MIKAMI and J. YOSHIMURA (Hokkaido University, Sapporo, Japan) (WCCM II - World Congress of Computational Mechanics, 2nd, Universitaet Stuttgart, Germany, Aug. 27-31, 1990, Selected Papers. A92-54242 23-39) Computers & Structures (ISSN 0045-7949), vol. 44, no. 1-2, July 3, 1992, p. 343-351. refs Copyright

Eigenfunction expansions and integrodifferential equations are employed with the collocation method to solve for the vibrations of shells of revolution subjected to fluid motion. Fluid regions internal or external to the shells are modeled with the eigenfunction expansions, and the integrodifferential expressions describing the shell's motion are solved by using the roots of the orthogonal polynomial as collocation points. The method is tested by means of examples using cylindrical, spherical, and hyperboloidal shells. The results indicate that accurate results can be achieved by using only small numbers of collocation points. The method is proposed as a numerical check for such procedures as finite-element analysis. C.C.S.

A92-54272

THE RIGID BODIES-SPRING MODELS AND THEIR APPLICATIONS TO THREE-DIMENSIONAL CRACK PROBLEMS

A. KIKUCHI (Nippon Steel Corp., Tokyo, Japan), T. KAWAI (Tokyo, Science University, Japan), and N. SUZUKI (Nippon Steel Corp., Tokyo, Japan) (WCCM II - World Congress of Computational Mechanics, 2nd, Universitaet Stuttgart, Germany, Aug. 27-31, 1990, Selected Papers. A92-54242 23-39) Computers & Structures (ISSN 0045-7949), vol. 44, no. 1-2, July 3, 1992, p. 469-477, 479, 480. refs Copyright

This paper examines the practical application of the rigid-bodies-spring model (RBSM) as fashioned by Kawai et al. (1987) and Kikuchi et al. (1989) to the determination of fracture criteria. The theoretical basis of the method is reviewed giving a discrete 3D element that can lead to convergency of elastic solutions. The Mohr-Coulomb law is adopted for the yield criterion of the spring constants, and stable/dynamic crack propagation is treated with the RBSM. The method is employed numerically for a rectangular element consisting of five tetrahedral subelements. Potential fracture criteria are derived with the RBSM for the case of stable crack growth in an arbitrarily shaped initial crack. The extensive illustrations and numerical results compare favorably with experimental data showing that Mohr-Coulomb's law is more suitable than von Mises' for 3D crack problems. C.C.S.

A92-54544

HYPERVELOCITY IMPACT OF MICROPROJECTILES ON LAYERED TARGET PLATES BY MAGNETO-PLASMA ACCELERATOR

HIDEKI TAMURA, KEIJI UEDA, TETSU FUSHIDA, and AKIRA B.

SAWAOKA (Tokyo Institute of Technology, Yokohama, Japan) Research Laboratory of Engineering Materials, Report (ISSN 0385-3799), no. 17, 1992, p. 333-349. refs

The hypervelocity-impact simulation of micrometeoroids or microdebris on a shielding bumper of a spacecraft was conducted by using a magnetoplasma accelerator. Glass beads of several hundred micrometers in diameter were chosen as such microprojectiles. Some kinds of double-layered target plates consisting of distinct materials were chosen as the outer wall of a double-walled bumper. The impact at a hypervelocity higher than 3 km/s induced the formation of craters or perforations on target plates. The morphology of the perforations and the dispersion of the secondarily-produced debris were examined with respect to the dependence on the target-plate structure. The perforation morphology and the debris dispersion obviously depended on the plate structure. Author

A92-54858

EFFECTS OF BRAZING TEMPERATURE ON JOINT PROPERTIES OF SiC FIBER REINFORCED ALUMINUM ALLOY MATRIX COMPOSITES

HIROSHI MORIMOTO, TAKASHI TANAKA, TOHRU SAITO (Nippon Steel Corp., Sagamiara, Japan), and KATSUTOSHI YAMADA (Nippon Steel Corp., Kawasaki, Japan) IN: Advances in joining newer structural materials; Proceedings of the International Conference, Montreal, Canada, July 23-25, 1990. Oxford and Elmsford, NY, Pergamon Press, 1990, p. 137-142. Research sponsored by Society of Japanese Aerospace Companies, Inc. refs Copyright

An aluminum alloy matrix composite reinforced by SiC fibers is brazed at different temperatures to study the effects of brazing temperature on joint properties. Brazing is performed at 0.005 Pa and 823-873 K for 1800 sec with an Al alloy filler foil 0.05 mm in thickness, and the brazing is followed by shear tensile tests, MMC tensile tests, and observations with a hot stage microscope. Maximum joint strength of 77.7 MPa is obtained at 853 K, and the strength of the brazed interface increases with temperature generally. The tensile strength of MMCs are found to degrade at room temperature after heat treatments at more than 823 K. The reaction between the fibers and the matrix metal is enhanced when the melting point of the matrix metal is close to the brazing temperature. This relationship demonstrates the importance of controlling temperature during the brazing of MMCs with Al alloys. C.C.S.

A92-56024

STRUCTURAL OPTIMIZATION OF A CANTILEVERED BEAM SUBJECT TO COMBINED STATIC LOADINGS

TOSHIFUMI NEKOHASHI, NAOHIRO IBOSHI, and TOMOARI NAGASHIMA (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 96-99. In Japanese. refs

A basic study concerning the structural optimization of a cantilevered beam subject to combined static loadings is conducted. The minimum deflection problem is formulated as an optimization problem involving inequality constraints and solution procedure using a conjugate gradient algorithm is presented. Optimum area distributions are determined numerically for various combinations of lateral and axial loadings including variable axial and lateral loadings both of which are simulated centrifugal force and air loadings for a rotor blade in hover. Effects of differences in applied loading conditions on the optimum solutions are discussed. Author

A92-56094

FATIGUE CRACKING THRESHOLD PREDICTION OF TRANSPORT AIRPLANES

GENKICHI FUJIWARA (Japan Airlines Co., Ltd., Tokyo) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 428-431. In Japanese.

39 STRUCTURAL MECHANICS

Current aging airplane service data have identified that there are more cracked airplanes with increasing fleet age, and possibly several fatigue cracks in some of the cracked airplanes. Moreover, multiple site damage in some of the cracked airplanes is not only an economic problem, but may also impact safety considerations. This paper discusses a method which will estimate the fatigue life thresholds of the aircraft structure's detail from fleet service experience, and also addresses the phenomena of multiple site damage from the operator's viewpoint. Author

A92-56270

THE STRENGTH OF CERAMIC-METAL BONDED JOINTS WITH INSERT METAL LAYER AND THEIR ANALYTICAL EVALUATION

MASATO MURATA and YOSHIHIKO MUKAI (Osaka University, Suita, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 4, no. 466, July 1992, p. 1101-1107. In Japanese. refs
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The effects of plastic deformation and the layer thickness on the stress singularity and the bond strength were investigated. It was found that the soft inserted material acts to relieve stress at the bonded interface, with the effect increasing with decreasing thickness of inserted metal. When a large plastic deformation concentrates at the bonded interface, the fracture strength decreases. In addition, the stress singularity was found to decrease as the Young's modulus of the insert metal increased. I.S.

A92-56271

MECHANICAL BEHAVIOR OF LAMINATED CARBON FIBER COMPOSITES UNDER PIN LOADING AND AFFECTING FACTORS ON THE BEARING STRENGTH

HIRONORI MAIKUMA and KENJI KUBOMURA (Nippon Steel Corp., Kawasaki, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 4, no. 466, July 1992, p. 1114-1120. In Japanese. refs
Copyright

Results are presented on measurements of the bearing strength of four pitch-based and two PAN-based carbon-fiber composite materials of (0 deg/ +45 deg/ 90 deg)_{3s} laminate specimens. The bearing strength was correlated with the mechanical properties of longitudinal reinforcing fibers, and with observations of microstructural damage. It was found that, in both the high tensile and high modulus carbon-fiber composite materials, the full bearing strength develops when the edge to distance ratio equals to or is larger than 3.0, and the side distance ratio is equal to or is larger than 4.0. As the fiber strain to failure becomes higher and also as the longitudinal compressive strength of unidirectional composites becomes higher, the bearing strength becomes higher. No correlation was found between the tensile strength of the fiber and the bearing strength. I.S.

A92-56272

DAMPING ANALYSIS AND EXPERIMENT OF CARBON FIBER/PEEK LAMINATES

YOSHIO AOKI (Nihon University, Funabashi, Japan), O-IL BYON (Nihon University, Narashino, Japan), and KAORU HASUMI (Toshiba Co., Ltd., Tokyo, Japan) Japan Society of Materials Science, Journal (ISSN 0514-5163), vol. 4, no. 466, July 1992, p. 1121-1125. In Japanese. refs
Copyright

This paper presents an analytical method for predicting flexural damping capacity of laminated composite beams made of carbon fiber reinforced thermoplastics (CF/PEEK). The effects of fiber orientation angle, stacking sequence, and the laminate geometry on flexural damping capacity and resonance frequency are discussed by decomposing the laminate energy dissipation associated with each of three resulting stress components. Each of the energy dissipation terms is then identified, and their effects on damping capacity are examined by calculating their contributions to the total laminated energy dissipation. For comparison with the analytical results, an experimental study for measuring damping capacity and resonance frequency of a cantilever laminated

composite beam was carried out by an impulse-frequency response technique. The good agreement obtained between the analytical and the experimental results of off-axis and cross-ply laminates shows that the analytical method developed is satisfactory for predicting flexural damping and resonance frequency. Author

N92-18485# National Aerospace Lab., Tokyo (Japan). Airframe Div.

VIBRATION TESTS OF LONG PLATE STRUCTURAL MODEL [OBIITA KOZO MOKEI NO SHINDO SHIKEN]

YASUKATSU ANDO, MASAKATSU MINEGISHI, YUJI MATSUZAKI, and KUNIO KUMAKURA Jul. 1990 33 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-625; JTN-92-80293) Avail: CASI HC A03/MF A01

In order to establish a test method of the sine wave multipoint forced oscillation test, the vibration test using the multipoint forced oscillation analysis system of the vibration test facility was performed. As the analysis method, the normal mode method (MODAP) and the transfer function method by forced oscillation (MODAT SINE) were adopted. As the test model in the test, long plate structure mode was made. As a result of the test, technical experience of the vibration test using large structures was accumulated and problems to be solved in the future were identified. Author (NASDA)

N92-20645# National Inst. of Standards and Technology, Gaithersburg, MD.

PROCEEDINGS OF THE 23RD JOINT MEETING OF THE US-JAPAN COOPERATIVE PROGRAM IN NATURAL RESOURCES PANEL ON WIND AND SEISMIC EFFECTS Final Report

N. J. RAUFASTE Sep. 1991 639 p Meeting held in Tsukuba, Japan, 14-17 May 1991

(PB92-116425; NIST/SP-820) Avail: CASI HC A99/MF A06; also available SOD HC \$31.00 as 003-003-03107-1

Presented here are the proceedings of the 23rd Joint Meeting of the U.S.-Japan Panel on Wind and Seismic Effects. The meeting was held at the Public Works Research Institute, Tsukuba, Japan, during May 14 to 17, 1991. The papers were presented under seven themes: wind engineering, earthquake engineering, storm surge and Tsunamis, Joint Cooperative Research Program, International Decade for Natural Disaster Reduction, and summaries of Task Committee Workshop Reports. Author

N92-25403# National Aerospace Lab., Tokyo (Japan).

DEVELOPMENT OF PRE- AND POST-PROCESSOR SYSTEM FOR STRUCTURAL ANALYSIS [KOZO KAISEKI YO PURI/POSUTO PUROSESSA SHISUTEMU NO KAIHATSU NI TSUITE]

HIDEHITO OKUMURA, KUNIHICO OOTAKE, SHINICHI MINEO, OSAMU MOCHIZUKI, KUNIHICO KOJIMA, and KENJI SHINOHARA Oct. 1990 20 p In JAPANESE Original contains color illustrations (ISSN 0452-2982)

(NAL-TM-628; JTN-92-80315) Avail: CASI HC A03/MF A01

A new CAE (Computer Aided Engineering) system for use in the design and analysis of aerospace technology was developed at NAL. The central part of the CAE system is general purpose structural analysis programs. The pre-processor consisted mainly from the three dimensional form modeling system and the FEM (Finite Element Method) modeling system. The former systems generate data for the analysis by FEM and converts the generated data to the next programs. And the post-processor system mainly consists of a graphic visualization system of the calculated results. And the integrated pre- and post-processor of CAE system consists of interfaces and communication files for the linkage with related systems. This CAE system is able to perform a series of work from model building to evaluations of results by the use of graphic terminals, and detailed designs of large structure components are possible by the use of this system. The overall designs, functions, and performances of the pre- and post-processor in the CAE system for structure research and development system are reported. Author (NASDA)

43 EARTH RESOURCES AND REMOTE SENSING

N92-25404# National Aerospace Lab., Tokyo (Japan). Aeroengine Div.

ACOUSTIC EMISSION ON FLEXURAL FRACTURE TEST OF SiC/AL COMPOSITES

YASUSHI SOFUE and AKINORI OGAWA Nov. 1990 18 p In JAPANESE; ENGLISH summary (ISSN 0452-2982)

(NAL-TM-630; JTN-92-80328) Avail: CASI HC A03/MF A01

Fracture behavior of SiC/Al composites was investigated using three point flexural tests with Acoustic Emission (AE) measurement. Flexural tests were conducted for four different types of ply specimens (0 deg unidirectional, 0 deg unidirectional, 0 deg/90 deg ply, and +/- 45 deg ply) of each of the composite materials and the specimen of 6061 aluminum alloy. The AE amplitude was above 8 dB for the fiber breakage of the 0 deg unidirectional ply and 0 deg/90 deg ply specimen, while the 0 deg unidirectional ply and the +/- 45 deg ply specimen produced an AE amplitude below 72 dB for the interlaminar and interface fracture mode.

Author (NASDA)

N92-28836# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

QUATERNION AND EULER ANGLES IN KINEMATICS

ISAO YAMAGUCHI, TAKASHI KIDA, OSAMU OKAMOTO, and YOSHIKI OOKAMI Jun. 1991 18 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-636; JTN-92-80363) Avail: CASI HC A03/MF A01

A summary of quaternion in the kinematics of rigid body dynamics is presented. Quaternion is a four parameter system for specifying the orientation of a rigid body. Four parameters of quaternion are updated by integrating linear differential equations whose coefficients are the angular velocity of the body. After describing the coordinate systems and vectors, quaternion is introduced. Then, using a comparison with the Euler angles, typical presentation of body orientation and the relationships between quaternion and angular velocity are discussed. Finally, a computer simulation algorithm is derived to solve rigid body dynamics using quaternion.

Author (NASDA)

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GEOSCIENCES (GENERAL)

A92-23373

COORDINATED GROUND-BASED MAGNETIC OBSERVATIONS FOR STUDIES ON RESPONSE OF THE MAGNETOSPHERE AND MAGNETOSPHERE-IONOSPHERE COUPLING (COMOSM)

STEP GBRSC News, vol. 1, Aug. 1991, p. 3-12.

The COMOSM program is described in terms of objectives, observation methodology and locations, instrumentation, data-analysis techniques, and the specific requirements for the four countries involved. Established magnetometer networks and geomagnetically conjugate stations in Canada, Scandinavia, Greenland, and Great Britain are employed to study magnetospheric and ionospheric issues relevant to solar-wind plasma and energy flows. The chains of stations are capable of collecting and distributing the key data for the support of the long-range solar/terrestrial program.

C.C.S.

A92-28025

WEATHER SATELLITES: SYSTEMS, DATA, AND ENVIRONMENTAL APPLICATIONS

P. K. RAO, ED., SUSAN J. HOLMES, ED., RALPH K. ANDERSON, ED. (NOAA, NESDIS, Washington, DC), JAY S. WINSTON, ED., and PAUL E. LEHR, ED. Boston, MA, American Meteorological Society, 1990, 516 p. No individual items are abstracted in this volume.

(ISBN 0-933876-66-1) Copyright

The present review of weather-satellite systems, data, and environmental applications encompasses the evolution of space-based weather observation, national observing capabilities, sensor data and processing, climate and meteorological applications, applications to land, agriculture, and ocean sciences, and some future directions. Specific issues addressed include U.S. operational polar and geostationary satellites, the Japanese GMS, remote sensing instrumentation, the Argos data collection and location system, satellite data product processing and archiving, atmospheric soundings, and image display and analysis systems. Also addressed are stereoscopic measurements, convective-scale weather analysis and forecasting, aviation and marine applications, and applications to the study of thermal anomalies, the earth-radiation budget, stratospheric monitoring, and vegetation monitoring, and reference is made to the potential of a polar orbiting platform.

C.C.S.

43

EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

A92-12240

GCP ACQUISITION USING SIMULATED SAR AND EVALUATION OF GCP MATCHING ACCURACY WITH TEXTURE FEATURES

KOHEI ARAI (Saga University, Japan) International Journal of Remote Sensing (ISSN 0143-1161), vol. 12, Nov. 1991, p. 2389-2397. refs

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A method is proposed for ground control-point (GCP) acquisition using a simulated synthetic-aperture radar (SAR) image derived from a digital-elevation model (DEM). Also proposed is a method for the evaluation of the accuracy of GCP matching with texture features from a reference GCP-chip image. Results from experiments with simulated GCP-chip images as reference images and geometrically distorted GCP-chip images, derived using simulated SAR images as current images, show good coincidence with GCP matching accuracy in terms of pixel distances between matched GCP points in reference and current chip images and texture features. Based on the proposed methods, GCP-chip images can be generated from a DEM, and GCP-matching accuracy can be evaluated with texture features of simulated SAR from a GCP-chip image.

Author

A92-17140

ESTIMATING GRAIN YIELD OF MATURING RICE CANOPIES USING HIGH SPECTRAL RESOLUTION REFLECTANCE MEASUREMENTS

MICHIO SHIBAYAMA and TSUYOSHI AKIYAMA (National Institute of Agro-Environmental Sciences, Tsukuba, Japan) Remote Sensing of Environment (ISSN 0034-4257), vol. 36, April 1991, p. 45-53. Research supported by Ministry of Agriculture, Forestry and Fisheries of Japan. refs

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A92-18909

REGIONAL MAPPING OF EVAPOTRANSPIRATION RATES USING MOS-1 VTIR DATA

TAPAN J. MAJUMDAR (Indian School of Mines, Dhanbad, India) ITC Journal (ISSN 0303-2434), no. 2, 1991, p. 86-89. refs

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The visible and thermal IR radiometer (VTIR) deployed onboard the Marine Observation Satellite is used to provide data for estimating regional evapotranspiration. The data are taken from an area in Thailand for parameters that are included in a simplified model of the surface energy budget. From the theoretical description a look-up table was generated for momentary

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evapotranspiration as a function of surface temperature and daily evapotranspiration. Three distinct regions are identified on the momentary evapotranspiration map for areas incorporating rice, uncultivated land, and wet land. In situ evapotranspiration data are presented which support the rates derived analytically from MOS-1 data. The results indicate that VTIR data from MOS-1 and similar satellites can be used in micrometeorologic and agroclimatologic studies of cropland regions. C.C.S.

A92-30445

COMPARISONS OF INDICATRICES OF DESERT AND URBAN AREAS OBTAINED FROM LANDSAT MSS DATA

HIROSHI OKAYAMA (Chiba University, Japan) and RONALD J. P. LYON (Stanford University, CA) Applied Optics (ISSN 0003-6935), vol. 31, March 20, 1992, p. 1279-1285. refs
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The indicatrices of ground glass surfaces were obtained as a measurement of their roughness and expressed by the Minnaert constant k . The indicatrices were also obtained for downtown areas of San Francisco and Berkeley and the desert areas in Nevada and California by using Landsat multispectral scanner (MSS) data with varying sun elevations. The values of k for each training area were obtained. Finally the biconical spectral reflectance of sand collected from the desert of the training areas was measured in the laboratory, and the computed values of k were compared with those derived from the Landsat MSS data. Author

A92-34920

A PROPORTION ESTIMATION OF MIXED PIXEL (MIXEL) WITH PREVIOUSLY ESTIMATED PROPORTIONS OF NEIGHBORING MIXELS

KOHEI ARAI, YASUNORI TERAYAMA, and KENBU TERAMOTO (Saga University, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 313-316. refs
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A proportion estimation of mixed pixels (mixels) based on the inversion problem solving technique with a previously estimated proportion of neighboring mixels is proposed. First, homogeneous areas are extracted and classified. Then spatial features such as line-likeness, area-likeness, etc. and properties such as directionality, length, width, etc. of heterogeneous areas are calculated. This is followed by referencing of contextual information with rotational information. Experimental results with simulation data show that the proposed method is superior to the previously proposed conventional method with a generalized inverse matrix by 81 times in terms of root-mean-square error. I.E.

A92-34929

ANALYSIS OF GREEN AREA CHANGE IN AND AROUND METROPOLIS USING LANDSAT AND CENSUS DATA

NOBUYUKI MIZUTANI, HIDEAKI MIYAMOTO, SIEJIRO HAYAKAWA (Asia Air Survey Co., Ltd., Atsugi, Japan), MASAO KATO, and KENJI KAMIGAWARA (Environmental Agency of Japan, Tokyo) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 359-362. refs
Copyright

A forecast is given pertinent to the green area in the Tokyo, Japan, metropolitan area up to the year 2000. These results will help to determine greenery policies and plan urban development projects for the future. The information is based on green area data obtained from Landsat data and statistical population data gathered from census data. This study shows the effectiveness of combining remote sensing data with other data to present an index for effective utilization of environmental resources. I.E.

A92-34938

MEASUREMENTS OF SOIL BACKSCATTER WITH A 60 GHZ SCATTEROMETER

HIROMICHI YAMASAKI, JUN AWAKA, AKIRA TAKAHASHI, KEN'ICHI OKAMOTO, and TOSHIO IHARA (Communications Research Laboratory, Koganei, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 403-406. refs

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Indoor experiments to measure the backscattering coefficient of a soil surface were performed using a 60-GHz scatterometer. The roughness of the soil surface was also measured by a laser profile meter to get the roughness parameters such as standard deviation and correlation length. Incidence angle dependence of the measured backscattering coefficient showed distinctive features according to the roughness of soil surface. These results were compared with estimates from a small perturbation theory. I.E.

A92-34996

GLOBAL REMOTE SENSING PROGRAMS IN JAPAN - SPECIAL EMPHASIS ON EARTH RESOURCES

YOSHINORI ISHII (Tokyo, University, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 709-712.

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A discussion is presented of the (1) basic structures of Japanese governmental organizations for space remote sensing, (2) approved and planned projects and their objectives, and (3) related research activities. Two satellites, JERS-1 (1992 by H-1) and ASTER (1998 by NASA polar orbit platform, or NPOP), have also been planned. Their original objectives are for the exploration of nonrenewable natural resources such as petroleum and minerals. Sensor specifications are: (1) high ground resolution, especially for VNIR, (2) stereo imaging, (3) SAR (synthetic aperture radar), on JERS for topography mapping, (4) many-channels for SWIR and TIR. These features also have great potential for global land observation. From this viewpoint, basic ideas and geoscientific potentials are discussed. I.E.

A92-35090

DEVELOPMENT OF MONITORING SYSTEM FOR TROPICAL RAIN FOREST MANAGEMENT IN THE PENINSULA MALAYSIA - THE JOINT MALAYSIA-JAPAN RESEARCH PROJECT ON REMOTE SENSING

HARUO SAWADA, OSAMU NAKAKITA, YOSHIO AWAYA (Forestry and Forest Products Research Institute, Tsukuba, Japan), KHALI AZIZ HAMZAH, and AZUMAN HASSAN (Forest Research Institute, Kuala Lumpur, Malaysia) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1153-1156. refs

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A92-35128

EVALUATION OF RADIOMETRIC PERFORMANCE OF MOS-1/MOS-1B MESSR

KOREHIRO MAEDA and MASAO NAKAI (NASDA, Hatoyama, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1345-1347. refs
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MOS-1 (Marine Observation Satellite-1) and MOS-1b were launched on February 19, 1987, and February 7, 1990, respectively. MOS-1 has four mission instruments: the MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal-Infrared Radiometer), MSR (Microwave Scanning Radiometer), and the DCST (Data Collection System Transponder). The MESSR has two systems, and each system has two telescopes. The radiometric performance of the MESSR is

evaluated by a uniform ocean-area and verification experiment. Some results on the radiometric characteristics of the MOS-1/MOS-1b MESSR are presented. I.E.

A92-35164 RADAR BACKSCATTERS FROM VEGETATION - REVIEW OF A LABORATORY-BASED MEASUREMENT TECHNIQUE

HARUTO HIROSAWA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1519-1522. refs

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The author reviews a technique developed for studying the backscattering characteristics of vegetation. An extended target composed of vegetation is formed on a turntable, and backscattering is measured while the target is rotated. The technique has been applied to the study of backscattering from trees. It has also been used to study the polarimetric microwave signature of random media. I.E.

A92-35174 MEASUREMENT OF DIELECTRIC CONSTANTS OF POLAR AND ARTIFICIAL ICE AT 10 GHZ

SHUJI FUJITA, MANABU SHIRAIISHI, and SHINJI MAE (Hokkaido University, Sapporo, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1567-1570. refs

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The dielectric constants of ice in X-band (10 and 9.7 GHz) were measured by the standing wave method with polar ice and with artificial ice in which ionic impurities of H₂SO₄ and HNO₃, with concentration between about 1 ppm and 1000 ppm, were doped. The real part of permittivity was basically determined by density for all samples. It slightly increased with temperature. The gradient of the real part and loss tangent with temperature, and the loss tangent itself, were enhanced when a higher concentration of impurity was doped in ice. Dielectric dispersion was found in samples with impurity concentrations of less than 2 ppm at temperatures between -10 C and -30 C. I.E.

A92-35223 A MULTI-TEMPORAL CLASSIFICATION METHOD USING DEMPSTER-SHAFFER MODEL

HARUHISA SHIMODA, SUN-PYO HONG, KIYONARI FUKUE, and TOSHIBUMI SAKATA (Tokai University, Tokyo, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1831-1834.

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Three new classification methods for multitemporal images are proposed. A likelihood addition method, a likelihood majority method, and a Dempster-Shafer rule method. Basic strategies using these methods are to calculate likelihoods for each set of temporal data and to combine obtained likelihoods for final classification. These three methods use different combining algorithms. From classification experiments, the following results were obtained. The method based on the Dempster-Shafer rule of combination showed about 12 percent improvement of classification accuracies compared to a conventional method. This method needed about 16 percent more processing time than the conventional method. The other two proposed methods showed 1 percent to 5 percent increases of classification accuracy. However, the processing times of these two methods are almost the same as that of the conventional method. I.E.

A92-35239

RADIANCE CHARACTERISTICS OF ALLUVIAL, BLACK AND RED SOILS AS INFLUENCED BY DIFFERENT AGRICULTURAL MANAGEMENT PRACTICES

K. K. MISHRA (Kagoshima University, Japan), N. KALRA, D. K. DAS (Indian Agricultural Research Institute, New Delhi, India), E. ISHIGURO, and M. MIYAZATO (Kagoshima University, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1923-1926. refs

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Investigations of soil spectral reflectance were carried out by remote-sensing techniques. Spectral data at different wavelengths over the visible and IR-regions were collected for alluvial, black (alfisols), and red (vertisols) soils over seven tillage-moisture-straw mulch treatments with a portable spectroradiometer. From the results it is concluded that different soil surface conditions resulting from different soil management practices can be distinguished through measurement and derived indices. The spectral behavior and soil background reflectances are different in alluvial, black, and red soils. Hence, in using models relating spectral indices to crop growth variables, due consideration must be given to the effect of soil background reflectance of the particular soil group. I.E.

A92-35290

HIERARCHICAL CLASSIFICATION OF LANDSAT TM IMAGE USING SPECTRAL AND SPATIAL INFORMATION

T. KUSAKA and Y. KAWATA (Kanazawa Institute of Technology, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 2187-2190. refs

Copyright

A hierarchical classification method is described that consists of the following procedures: (1) edge-based segmentation of the satellite image; (2) classification of homogeneous areas; and (3) detection of linear structures such as roads. The Landsat Thematic Mapper (TM) image is segmented into numerous primitive regions of nearly uniform color. In the classification analysis of homogeneous areas, the primitive region is treated as a fundamental element of an image. It is found that the classification using multispectral information about primitive regions gives almost the same results as the per-pixel classification. It is also shown that linear structures such as roads correspond to border pixels between primitive regions and some border pixels can be successfully detected with the aid of a digitized road map. I.E.

A92-35480

LAND COVER MONITORING IN ASIA BY NOAA GVI DATA

RYUTARO TATEISHI and KOJI KAJIWARA (Chiba University, Japan) Geocarto International (ISSN 1010-6049), vol. 6, no. 4, Dec. 1991, p. 53-64. refs

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NOAA/AVHRR Global Vegetation Index (GVI) data of Asia in 1983 and 1987 were used to evaluate their usefulness for global land cover monitoring. Color composite images of monthly GVI data and color composite images of principal components from 12 successive monthly GVI data were found to be useful for visual interpretation of seasonal vegetation dynamics. The results of cluster analysis applied to monthly GVI data for a one-year period, indicate that unsupervised classification method is useful for global or continental land cover classification without ground truth. In order to detect land cover changes, the difference between the 1983 and 1987 12-month GVI data was calculated. The results show that it is difficult to detect land cover changes due to cloud contamination in monthly GVI data and poor registration of GVI products. Author

A92-38211

EARTH OBSERVATION FROM SPACE

TOSHIBUMI SAKATA (Tokai University, Tokyo, Japan) IN:

43 EARTH RESOURCES AND REMOTE SENSING

International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 91, 92. In Japanese.

Satellite observation and computer image processing systems for earth research are presented. It is suggested that an international monitoring system be established making use of satellites for the study of natural hazards. Y.P.Q.

A92-39406

MONITORING OF THE VEGETATION CONDITION BY TASSELED CAP TRANSFORMATION - INVESTIGATION OF U.S.A. DROUGHT DISASTER IN 1988

MITSUNORI YOSHIMURA (Remote Sensing Technology Center of Japan, Tokyo) and TAICHI OSHIMA (Hosei University, Koganei, Japan) IN: 1991 ACSM-ASPRS Annual Convention, Baltimore, MD, Mar. 25-29, 1991, Technical Papers. Vol. 3. Bethesda, MD, American Congress on Surveying and Mapping and American Society for Photogrammetry and Remote Sensing, 1991, p. 506-515. refs

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A method is proposed for calculating each coefficient of TM tasseled cap features by DN values without physical characteristics. In order to verify the effect of this transformation, the degree of the drought disaster in 1988 is investigated by applying the above method to multitemporal Landsat TM data for the granary area in the suburbs of St. Louis, Missouri. Two periods of Landsat TM data which were obtained before the drought (1987) and in the year of the drought (1988) were used. Changes in the thermal condition were also detected using a TM thermal band (band 6). This application of tasseled cap transformation is confirmed as a useful method for monitoring the condition of vegetation. P.D.

A92-40977

ACCURATE ESTIMATION OF 1.5 M-HEIGHT AIR TEMPERATURE BY GMS IR DATA

I. HORIGUCHI, H. TANI (Hokkaido University, Sapporo, Japan), and T. MOTOKI (Japan Meteorological Agency, Tokyo) IN: International Symposium on Remote Sensing of Environment, 24th, Rio de Janeiro, Brazil, May 27-31, 1991, Proceedings. Vol. 1. Ann Arbor, MI, Environmental Research Institute of Michigan, 1992, p. 301-307. refs

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The regression equations between surface temperature derived from GMS (Geostationary Meteorological Satellite) IR data and air temperature from AMeDAS (meteorological observation site) were calculated in Hokkaido, Japan. The hourly mean deviation between estimated air temperature from GMS and AMeDAS air temperature was calculated for each AMeDAS site. AMeDAS sites were classified by cluster analysis into 10 types according to the pattern of the hourly mean deviation. The regression equations between surface temperature from GMS and air temperature from AMeDAS with similar types of deviation in five areas of Hokkaido were recalculated using four methods. Results using the district-cluster method were the most accurate. Author

A92-47954

A MAPPING METHOD FOR VISSR DATA

SEIICHIRO KIGAWA (Meteorological Satellite Center, Kiyose, Japan) Meteorological Satellite Center, Technical Note (ISSN 0388-9653), no. 23, Nov. 1991, p. 15-35.

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A coordinate transformation method that uses orbit and attitude prediction data to determine the position on the earth (geodetic coordinates) that corresponds to a Visible and IR Spin Scan Radiometer (VISSR) image pixel (VISSR frame coordinates) is described. A significant feature of this transformation technique is that it calculates important information that can be used in other digital processing methods. The applicable theory and sample transformation programs are described. R.E.P.

A92-48243

MOS AND SEASAT IMAGE GEOMETRIC CORRECTIONS

THIERRY TOUTIN (Canada Centre for Remote Sensing, Ottawa)

and YVES CARBONNEAU (Consultants TGIS, Inc., Anjou, Canada) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 30, no. 3, May 1992, p. 603-609. refs

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An analysis of sensor and satellite motion geometries, in conjunction with the use of a photogrammetric approach, yields a rigorous mathematical model for the geometric correction and rectification of raw MOS-MESSR and Seasat-SAR images. The final accuracy of these geometric corrections is of the order of 25 m for both data types, on the basis of only six ground-control points; an enhancement of such points' definition should improve final accuracy to 17 m for MOS-MESSR images, and 15 m (or merely 1 pixel) for Seasat-SAR images. A coarse digital-elevation model can be used for ortho-image generation without compromising this level of accuracy. O.C.

A92-51465

RECENT ADVANCES IN 3D APPLICATIONS OF REMOTE SENSING AND GIS IN JAPAN

SHUNJI MURAI, MO XI, SUKIT VISESHSIN, MASATAKA TAKAGI, YOSHIKI HONDA (Tokyo, University, Japan), SHIRO OCHI (UN, Center for Regional Development, Nagoya, Japan), and MITSU HARU TOKUNAGA (Central Computer Service Co., Ltd., Tokyo, Japan) (Workshop on 3D in Remote Sensing and GIS - Systems and Applications, Oberpfaffenhofen, Federal Republic of Germany, Sept. 16-22, 1991, Selected Papers. A92-51457 21-43) ITC Journal (ISSN 0303-2434), no. 1, 1992, p. 55-58.

Copyright

Three kinds of 3D applications of remote sensing and GIS in Japan are described: data acquisition for digital elevation models (DEMs), data processing and analysis, and 3D image output. The output from combinations of remote sensing images, DEMs, hill shading, drainage patterns, and other thematic variables is illustrated. C.D.

A92-52835

A SUPERVISED THEMATIC MAPPER CLASSIFICATION WITH A PURIFICATION OF TRAINING SAMPLES

K. ARAI (Saga University, Japan) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, no. 11, July 20, 1992, p. 2039-2049. refs

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A system for purification of training samples for the pixel-wise maximum likelihood classification is presented. In this technique, pixels that show comparatively high local spectral variability as well as spectrally separable classes are removed from the preliminary designated training samples. A case using agricultural TM data from a site located at Melfort, Saskatchewan, shows that separability can be enhanced by a factor of 3.78 times in terms of divergence between a specific class pair; most importantly, a 20.6 percent improvement of probability of correct classification can be achieved for a specific class. R.E.P.

A92-53732

APPLICATIONS OF MOS-1 DATA TO EARTH ENVIRONMENT MONITORING AND FUTURE GLOBAL CHANGE MONITORING SYSTEM

KOREHIRO MAEDA (NASDA, Earth Observation Center, Hatoyama, Japan) and HIDEO SATOH IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1995-2001. refs

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The first Japanese earth observation satellite MOS-1 (Marine Observation satellite-1) was launched on Feb. 19, 1987 and MOS-1b was launched on Feb. 7, 1990. By using MOS-1 and MOS-1b, the MOS-1 observation system will contribute to the monitoring of the environment of the earth. In this paper, earth environment monitoring items are classified into three categories (ocean, land and atmosphere) and examples of applications are presented. A future earth monitoring system is presented in view of MOS-1 results. Author

A92-53734

MAP PROJECTION METHODS APPLIED TO MOS-1 EARTH OBSERVATION IMAGE DATA PRODUCTS

TETSUYA KODAMA, HIROYUKI WAKABAYASHI (NASDA, Earth Observation Center, Saitama, Japan), SHINJI OGAWA (NASDA, Tsukuba Space Center, Japan), and HIDEO SATOH (NASDA, Katuura, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2009-2013. refs

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An account is given of the cartographic projection methods employed by the MOS-1 earth observation image data processing system. The Multispectral Electronic Self-Scanning Radiometer, Visible and Thermal IR Radiometer, and Microwave Scanning Radiometer data are rendered in the Universal Transverse Mercator projection as a matter of standard practice; attention is given to the alternative projections of the Lambert conformal conic method, the polar stereo method, and the Space/Hotine oblique Mercator projection. O.C.

A92-55891

MAXIMUM LIKELIHOOD TM CLASSIFICATION - TAKING THE EFFECT OF PIXEL TO PIXEL CORRELATION INTO ACCOUNT

KOHEI ARAI (Saga University, Japan) Geocarto International (ISSN 1010-6049), vol. 7, no. 2, June 1992, p. 33-39. Research supported by NSERC. refs

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To investigate the effect of a pixel to pixel correlation on classification performance for TM data, some experiments have been conducted. One of the results shows that the pixel to pixel correlation in homogeneous field of TM data is larger than that of the simultaneously acquired MSS data. This implies that it is more important to take into account the pixel correlation for TM classification rather than MSS classification. To overcome the effect of the correlation, the following method have been investigated: (1) dividing the correlated image into several uncorrelated sub-images; and (2) based on the auto-regressive model, modifying the Gaussian statistical parameters for the correlated image to those for uncorrelated stochastic process. An example using agricultural TM data shows a slight improvement in the weighted means percentage of correct classification. Through the investigation of the correlation structures, a more realistic model for TM data has been developed. Author

N92-11497# Kagoshima Univ. (Japan). Faculty of Agriculture. A STUDY ON THE EFFECTS OF MT. SAKURAJIMA'S FALLING ASH OVER CROP AND FOREST AREAS USING IMAGE PROCESSING FOR LANDSAT-5, MOS-1, AND JAFSA DIGITAL DATA

E. ISHIGURO, KRISHNA KUMAR MISHRA, Y. HIDAKA, and M. MIYAZATO IN ESA, Physical Measurements and Signatures in Remote Sensing, Volume 2 p 509-512 May 1991 Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Mount Sakurajima is one of the most active volcanic mountains in Japan. It causes severe damage to the surrounding living environment by erupting huge amounts of volcanic ash. The importance of this was realized and the effects were evaluated of falling ash over agricultural fields, forests and cities using this remote sensing techniques. The changes in the spectral characteristics of vegetables covered with and without ash were measured by a spectroradiometer. The information was utilized for identifying the volcanic smoke and the areas affected by falling ash using a personal computer, an image processor for the LANDSAT 5, MOS-1, and Jafsa digital data. The results indicate the probability in evaluating the amount of falling ash. ESA

N92-11547# Kisarazu National Coll. of Technology (Japan). LASER INDUCED FLUORESCENCE OF GROWING CAMPHOR TREE LEAVES: INFLUENCE OF CHLOROPHYLL CONTENT ON LIF SPECTRAL SIGNATURE

KUNIO TAKAHASHI (Kisarazu National Coll. of Technology

(Japan).), T. NAKAMURA (Kisarazu National Coll. of Technology (Japan).), M. KOIZUMI (National Inst. of Agrobiological Resources, Ibaraki, Japan), H. KANO (Tsukuba Univ., Ibaraki (Japan).), and S. SUZUKI IN ESA, Physical Measurements and Signatures in Remote Sensing, Volume 2 p 753-756 May 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Fluorescence spectra induced by a laser light (Ar-laser, 477 nm and 488 nm, 3.5 mW) in intact camphor tree leaves were measured at room temperature by an Optical Multichannel Spectrometer (OMS) equipped with an image intensifier. Two peaks were observed in the fluorescence spectra. Resolution of peaks to emitter components with Gaussian shapes suggested that the peak near 685 nm were the bands related to photosystem 2 and that those near 740 nm were related to photosystem 1. The ratio increased along with progression of growth stages of the leaf associated with the increase of chlorophyll content. It was considered that fluorescence from photosystem 2 was reabsorbed by photosystem 1. Self absorption of fluorescence raises the conversion efficiency of solar energy to photochemical reactions in the leaves with dense chlorophyll. ESA

N92-16378 Saga Univ. (Japan).

UTILISATION PLANS FOR ADEOS CORE SENSORS, AVNIR AND OCTS Abstract Only

KOHEI ARAI IN New Brunswick Univ., Proceedings of the Thirteenth Canadian Symposium on Remote Sensing p 14 Jul. 1990

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, Ontario K2P 0J1 Canada

An investigation into user requirements for the utilization of advanced earth observing satellite (ADEOS) data has been conducted. ADEOS will carry two core sensors, ocean color and temperature scanner (OCTS), advanced visible and near infrared radiometer (AVNIR), and six mission instruments: improved limb atmosphere spectrometer (ILAS), interferometric mapper for greenhouse gasses (IMB), NASA scatterometer (NSCAT), polarization and directionality radiometer (POLDER), retroreflector in space (RIS), and total zone mapping spectrometer (TOMS). This paper describes all the results from the investigation of the user requirements of ADEOS data as well as the preliminary analysis of operation capability of ADEOS mission instruments. OCTS is designed for global monitoring of sea surface temperature and chlorophyll concentration. AVNIR is designed for local observation. User requirements determined for OCTS data included: many users want real time or near real time data; many users want data every day; and many want combinations of OCTS and other sensor data. Most users of AVNIR want system corrected data at a frequency of several times per year. CISTI

N92-16412 National Space Development Agency, Saitama (Japan). Earth Observation Center.

OCEAN MONITORING BY MOS-1

K. MAEDA and S. OGAWA IN New Brunswick Univ., Proceedings of the Thirteenth Canadian Symposium on Remote Sensing p 272-279 Jul. 1990

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, Ontario K2P 0J1 Canada

The National Space Development Agency of Japan (NASDA) launched the earth observing satellites, MOS-1 and MOS-1b on Feb. 19, 1987 and Feb. 7, 1990. In this paper, ocean monitoring sensors on the satellites are briefly described and some applications are presented. The multispectral electronic self scanning radiometer (MESSR) on MOS-1 has been used to monitor turbidity near the coast and around small islands. River effluents can be clearly seen. This sensor can be used to locate mackerel fishing grounds which are usually found near the coast near the interface between muddy and clear waters. The turbidity created by the eruption of an undersea volcano was also clearly seen. The visible and thermal infrared radiometer (VTIR) is capable of reliably measuring sea surface temperature in summer and winter. Sea ice can be monitored by microwave scanning radiometer

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(MSR). A brief discussion is presented of the planned Advanced Earth Observing Satellite (ADEOS) to be launched in 1995.

CISTI

N92-22866# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS OF THE SECOND SYMPOSIUM ON MOS-1 VERIFICATION PROGRAM

HIDEO SATOH, ed. and KOREHIRO MAEDA, ed. Dec. 1988 506 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 12-14 Jul. 1988

(JTN-92-80304) Avail: CASI HC A22/MF A04

The following topics were discussed: Marine Observation Satellite-1 (MOS-1), earth observation, satellite observation, satellite imagery, sea survey, infrared radiometers, microwave radiometers, visible radiometers, Visible and Thermal Infrared Radiometer, Microwave Scanning Radiometer, Multispectral Electronic Self-Scanning Radiometer, Data Collection System, ocean data acquisitions systems, earth surface observation, vegetation identification, timber identification, snow cover observation, rain rate observation, sea ice observation, atmospheric correction, geometrical correction, image analysis, image reconstruction, noise analysis of radiometer, radiometric characteristics, reception of MOS-1 data, cloud parameters, atmospheric parameters, sea surface temperature.

Author (NASDA)

N92-22867# National Space Development Agency, Tokyo (Japan).

OUTLINE OF MOS-1 MISSION EVALUATION

HIROSHI HORIGUCHI and YUKIE IIDA In its Proceedings of the Second Symposium on MOS-1 Verification Program p 1-9 Dec. 1988

Avail: CASI HC A02/MF A04

This paper summarizes the result of the evaluation of Marine Observation Satellite-1 (MOS-1) orbital performance. The evaluation covered the performance of the satellite hardware since the launch through the operational phase in orbit. MOS-1 is Japan's first medium altitude experimental earth observation satellite developed for establishing the nation's earth observation technology. The satellite was launched successfully from Tanegashima Space Center, NASDA (National Space Development Agency of Japan), by the N-2 Launch Vehicle on February 19, 1987. After one day in the orbit, it acquired earth-oriented normal attitude. During the succeeding three months, the orbital performance of the mission and bus equipment was thoroughly checked out. The result of this checkout showed the satellite performance to be generally satisfactory. Since the beginning of the routine satellite operation, MOS-1 has operated fairly well. There is no component failure yet and performance degradation of life-limited components is within the expected range. Regardless of the seasonal change of space environment, thermal and attitude telemetries has been maintained in small deviations. Up to now in satellite orbital operation, some minor problems were found, including the false execution of delayed command caused by Single Event Upset (SEU) of the command memory, and safety attitude retraction due to malfunction of the earth sensor.

Author (NASDA)

N92-22868# National Space Development Agency, Saitama (Japan). Earth Observation Center.

OUTLINE OF MOS-1 MISSION OPERATION

KOHEI ARAI In its Proceedings of the Second Symposium on MOS-1 Verification Program p 10-13 Dec. 1988

Avail: CASI HC A01/MF A04

In order to determine the Marine Observation Satellite-1 (MOS-1) operation schedule together with monitoring telemetry and mission data, Mission Management Organization (MMO) has been operating since the beginning of the mission check period. This report describes the method for mission operation scheduling and the monitoring of data together with the function of MMO installed at EOC (Earth Observation Center), NASDA (National Space Development Agency of Japan).

Author (NASDA)

N92-22869# National Space Development Agency, Saitama (Japan). Earth Observation Center.

RESULTS OF MOS-1 VERIFICATION PROGRAM (MVP)

KOREHIRO MAEDA, HIROYUKI WAKABAYASHI, MASANOBU SHIMADA, and HIDEO SATOH In its Proceedings of the Second Symposium on MOS-1 Verification Program p 14-25 Dec. 1988

Avail: CASI HC A03/MF A04

Marine Observation Satellite-1 (MOS-1) was successfully launched from Tanegashima Space Center, NASDA (National Space Development Agency of Japan) by N-2 Launch Vehicle on February 19, 1987. The MOS-1 has four mission instruments: (1) Multispectral Electronic Self-Scanning Radiometer (MESSR); (2) Visible and Thermal Infrared Radiometer (VTIR); (3) Microwave Scanning Radiometer (MSR); and (4) Data Collection System Transponder (DCST). All mission instruments were found to be satisfactory during the mission check period (three months after the launch), though there was an interference problem in DCS (Data Collection System) due to the outer radio interference source which was resolved by changing the frequency of Data Collection Platform (DCP). NASDA planned and initiated the MOS-1 Verification Program (MVP) to evaluate the MOS-1 observation system since March 1987. NASDA is conducting MVP in collaboration with the joint research organizations, domestic and foreign organizations. As a part of the MVP, NASDA conducted airborne experiments in summer and winter in several test sites in FY 1987 in Japan on passing days of MOS-1 and will conduct summer airborne experiments in FY 1988. In this paper, the outline of MVP will be described and some initial results of MVP will be presented.

Author (NASDA)

N92-22870# National Space Development Agency, Saitama (Japan).

DATA COLLECTION SYSTEM OPERATING ON JAPAN'S FIRST MARINE OBSERVATION SATELLITE: INFLIGHT EVALUATION OF THE SYSTEM PERFORMANCE

MASANOBU SHIMADA, TAKASHI YAMAZAKI, MASANOBU TSUJI, and NORITAKA TANIOKA In its Proceedings of the Second Symposium on MOS-1 Verification Program p 26-35 Dec. 1988

Avail: CASI HC A02/MF A04

The Marine Observation Satellite-Data Collection System (MOS-DCS) provides the opportunities to monitor the phenomena of the earth surface, with the utilization of the communication technology combined with the satellite in low-polar orbit. The mission objectives of the MOS-DCS are classified into location determination of DCP (Data Collection Platform), making use of the Doppler frequency measurement at ground station, and data communication through the satellite. Its servicing is restricted within the circle of about 5,000 km radius centered at the ground station, so the location accuracy depends not only on the errors concerning the measurement of some engineering parameters, such as Doppler frequency, synchronized time, and so on, but also on where the DCP is located. This paper discusses the location accuracy of the MOS-DCS, regarding the originated DCP location within its servicing area and some correction parameters, combined with some results of experiments and simulations. Moreover, it deals with the communication performance of the MOS-DCS.

Author (NASDA)

N92-22871*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PRELIMINARY RESULTS OF MOS-1 MSR, VTIR, AND MESSR DATA QUALITY EVALUATIONS AT NASA Abstract Only

ROY W. SPENCER, GARY J. JEDLOVEC, and ROBERT J. ATKINSON In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 36-37 Dec. 1988

Avail: CASI HC A01/MF A04

A preliminary evaluation of the Microwave Scanning Radiometer (MSR), the Visible and Thermal Infrared Radiometer (VTIR) and the Multispectral Electronic Self-Scanning Radiometer (MESSR) on the Marine Observation Satellite (MOS-1) has been performed. Data from these instruments have been analyzed using image processing systems at NASA's Marshall Space Flight Center (MSFC). Analysis of the MOS-1 orbital parameters and the MSR, VTIR, and MESSR scan geometries allow the use of software

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developed for the Man-computer Interactive Data Access System (McIDAS) at MSFC to navigate and re-map these data into different projections and to display it with other data bases at the same time. These data quality evaluations are preliminary and are based on a limited number of scenes. The goals of the evaluation are quite general but serve to address the basic quality of the data and its usefulness in deriving data products for case study investigations. The following goals have been partially addressed to date and will be further addressed later in this investigation: (1) Evaluate the general quality of the MSR, VTIR and MESSR data and their application to multi disciplinary investigations; (2) Determine the noise characteristics of the MSR and VTIR thermal channels, and compare these noise estimates and the radiometric accuracy to that of similar U.S. satellite imaging instruments; (3) Investigate the calibration accuracy of the MESSR data with respect to the use of the large linear array of detectors; (4) Study the usefulness of the high resolution water vapor measurements from the VTIR in understanding mesoscale atmospheric processes.

Author (NASDA)

N92-22872# European Space Agency. ESRIN, Frascati (Italy). Earthnet Program Office.

PROGRESS REPORT ON MOS-1 VERIFICATION. PROGRESS REPORT ON EUROPEAN MOS-1 DATA UTILISATION PROGRAMME (EMDUP)

LUIGI FUSCO and MARIANNE EGLEME /*In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 38-59 Dec. 1988*

Avail: CASI HC A03/MF A04

One data set was received from NASDA (National Space Development Agency of Japan) and it was analyzed in order to gain familiarity with the MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) data. The ESA (European Space Agency) MVP (Marine Observation Satellite-1 Verification Program) participation is based on the analysis of the European MOS-1 (Marine Observation Satellite-1) acquisitions and processing performed at Earthnet stations. ESA has been acquiring MOS-1 data in four stations since November 1987, but at present ESA has not yet generated MESSR and VTIR user products. The participation of the MVP and the anticipated support to other investigators is still on stand-by. The European MOS-1 Data Utilization Program (EMDUP) was defined in 1987 by the Earthnet Program Office to promote the utilization of MOS-1 data acquired in Europe. The number of MOS-1 products presently requested (or specified) by PIs are: 266 MESSR, 110 VTIR and 83 Microwave Scanning Radiometer (MSR) scenes.

Author (NASDA)

N92-22873# National Research Council, Bangkok (Thailand).

THE CURRENT STATUS OF MOS-1 ACTIVITY IN NRCT CHOOMPOL SWASDIYAKORN and CHANCHAI PEANVIJARN-PONG /*In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 60-68 Dec. 1988*

Avail: CASI HC A02/MF A04

Since the exchange of a verbal note on December 11, 1986, the governments of Thailand and Japan have been cooperating on the MOS-1 (Marine Observation Satellite-1) Project, which has two components: (1) co-operation on direct reception from MOS-1 satellite; and (2) joint research in the areas of remote sensing technology and applications of MOS-1 and other available data. The National Research Council of Thailand (NRCT), has carried on the project with the National Remote Sensing Coordinating Committee. The TMS (Thailand MOS-1 Station) under the MOS-1 Project is able to receive MOS-1 data of many countries in the South East Asia region. Therefore, the station is beneficial not only to Thailand and Japan, but also to the countries lying within the coverage zone of the station.

Author (NASDA)

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COUNTRY REPORT ON PRESENT STATUS AND PLAN FOR MOS-1 OPERATION WITH EMPHASIS ON AGRICULTURAL APPLICATIONS IN THAILAND Abstract Only

PONGPIT PIYAPONGSE /*In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 69 Dec. 1988*
Avail: CASI HC A01/MF A04

The Department of Agriculture has been conducting a joint research project with the National Institute of Agro Environmental Sciences (NIAES) of Japan to enhance the remote sensing application to agricultural production in the central plain of Thailand. The estimation of agricultural production in the central plain, namely rice, maize, sorghum, sugarcane, and other field crops were emphasized. The main objective is to enhance methodology and preparation to use MOS-1 (Marine Observation Satellite-1) data. The measurement of the spectral responses of various economic crops were done by NIAES radiometer. At present, LANDSAT-5 data were employed in this research, together with NOAA's data for the vegetation index study. The present status of the program is going well. The future plan for the utilization of MOS-1 Project will be a promising one after the completion of the MOS-1 receiving station in Bangkok this year. The future plan is for MOS-1 data to be utilized by the Department of Agriculture in accordance with the following theme: (1) The application of MOS-1 data to estimate agricultural production in the central plain and northeast Thailand; (2) The utilization of MOS-1 data to monitor the coastal resources of Thailand; (3) The application of MOS-1 data to natural hazards for crop damage monitoring; (4) The application of MOS-1 data together with NOAA and METSAT (Meteorological Satellite) for flood prediction; and (5) The application of MOS-1 data to agro-ecological zoning in Thailand.

Author (NASDA)

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MOS-1 VERIFICATION PROGRAM FOR FORESTRY APPLICATIONS IN THAILAND

BOONCHANA KLANKAMSORN and THONGCHAI CHARUPATT /*In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 70-75 Dec. 1988*

Avail: CASI HC A02/MF A04

The agreement of participation in the MOS-1 Verification Program was signed on 25 November 1987 by the director general of the Royal Forest Department and the president of the National Space Development Agency of Japan (NASDA). The focus of this program will be on using MOS-1 data for the classification of forest land into forest, non-forest, shifting cultivation, and forest types in four selected areas of Thailand. Unfortunately, to date, the Royal Forest Department has not received MOS-1 data from NASDA, but will receive the data around September 1988. The verification program will start in October 1988. The verification results of this program will be presented at the Third Symposium in February 1989.

Author (NASDA)

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STUDY ON THE ESTIMATION TECHNIQUES OF SPATIAL RESOLUTION CHARACTERISTICS FOR THE MESSR Interim Report

HAJIME KOSHIISHI, MASAO NAKA, and KOHZO HOMMA /*In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 76-81 Dec. 1988* Prepared in cooperation with National Space Development Agency, Japan

Avail: CASI HC A02/MF A04

This is an interim report on the research into the application of estimation techniques to the spatial resolution characteristics of an image sensor. A system parameter of interest is the estimation of spatial resolution characteristics of optical imaging sensors such as MESSR (Multispectral Electronic Self-Scanning Radiometer) after launch. In MOS-1 (Marine Observation Satellite-1) Verification Program (MVP), the computational techniques for estimating spatial resolution characteristics of satellite-based optical imaging sensor systems have been studied. Two techniques for estimating overall spatial resolution characteristics of image sensor system have been investigated; the frequency domain method (Fourier transformation) and spatial domain method (spatial convolution). Several factors affecting in estimation accuracy of the spatial resolution are investigated by using computational simulations. This paper presents an outline of the estimation methods of PSF (Point Spread

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Function) and MTF (Modulation Transfer Function) of an image sensor system, an analysis of effects by relative motion between platform (satellite) and ground scene, and some results of the estimation experiments for the PSF and MTF characteristics of MESSR using MOS-1 CCT (Computer Compatible Tape) data.

Author (NASDA)

N92-22877# Meteorological Research Inst., Tsukuba (Japan). Meteorological Satellite Observation System Research Div.
INVESTIGATION OF ATMOSPHERIC EFFECT TO MESSR, VTIR AND MSR, AND OBSERVATIONS OF THE OCEANIC PHENOMENA USING MSR

SYOICHI KOINUMA, TSUTOMU TAKASHIMA, YOZO TAKAYAMA, and KAZUHIKO MASUDA /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 82-86 Dec. 1988 Prepared in cooperation with National Space Development Agency, Japan

Avail: CASI HC A01/MF A04

The radiation measurement performance of the Visible and Thermal Infrared Radiometer (VTIR) on MOS-1 (Marine Observation Satellite-1) was examined by using simultaneous measurements of sea surface temperature. Observed brightness temperature by VTIR in the clear condition was compared with the brightness temperature calculated theoretically based on measured sea surface temperature and aerological data. For infrared window band (Band 3 and 4), the observed brightness temperatures agreed with the calculated temperature with R.M.S. (Root Mean Square) difference in temperature of 0.94 and 1.18 for Band 3 and 4, respectively. For the water vapor absorption band (Band 2), comparison in brightness temperature between observed and calculated data is difficult, because the radiation is strongly dependent on distribution of water vapor in the middle-to-upper troposphere. However, having a large deviation in temperature difference results shows higher correlation between them. Sea surface temperature obtained in R.M.S. indicated a temperature difference of 0.8 C by using Band 3 and 4 data.

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N92-22878# Meteorological Research Inst., Tsukuba (Japan). Oceanographical Research Div.
INVESTIGATION OF ATMOSPHERIC EFFECT ON MESSR, VTIR AND MSR AND OBSERVATIONS OF THE OCEANIC PHENOMENA USING MSR

AKIRA SHIBATA, YOSHIO SHINOHARA, KOJI UENO, and KENZO SHUTO /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 87-91 Dec. 1988 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Japan

Avail: CASI HC A01/MF A04

Three geophysical parameters retrieved from the MSR (Microwave Scanning Radiometer) data - accumulated water vapor, accumulated liquid water both over the ocean, and sea ice extent - are compared with the truth data of upper air observations of water vapor at Hachijo Island, the rain rate estimated by the radar located on Mt. Fuji, and a chart of sea ice, respectively. From these comparisons the MSR demonstrates a full performance expected in the planning stage, except for a possibility that the temperature at 23 GHz is higher than a theoretical value by about 5 K.

Author (NASDA)

N92-22879# Meteorological Research Inst., Tsukuba (Japan).
ATMOSPHERIC EFFECT ON THE OBSERVED BRIGHTNESS TEMPERATURE [KANSOKU KIDO NI OYOBOSU TAIKI NO EI KYO]

TADAO AOKI, YOSHINARI MIZUNO, KUNG HWA WANG (Meteorological Satellite Ground Station, Taiwan), KIYOTAKA SHIBATA, MASASHI FUKABORI, and TERUO AOKI /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 92-95 Dec. 1988 In JAPANESE Prepared in cooperation with National Space Development Agency, Japan

Avail: CASI HC A01/MF A04

A comparison was made among the observed data from MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared

Radiometer) and the calculated data of the Line-by-Line (LBL) Model and the high speed multivariate band model which was recently developed. As a result, the calculated data was systematically smaller than the observed one. The radiative transfer model in the microwave region was developed, and a comparison of data from this model and MSU (Microwave Sounding Unit) data of TIROS-N (Television Infrared Observation Satellite-N) satellites showed systematic differences in data among satellites.

Author (NASDA)

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EVALUATION OF THE MSR ANTENNA PATTERN AND RETRIEVAL ERROR OF WATER VAPOR CONTENT

TAKEYUKI OJIMA, HIROSHI KUROIWA, HIDEO SATOH, and KOREHIRO MAEDA /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 96-102 Dec. 1988 Prepared in cooperation with National Space Development Agency, Japan

Avail: CASI HC A02/MF A04

Data processing of 20 scenes of the MSR (Microwave Scanning Radiometer) aboard MOS-1 (Marine Observation Satellite-1) has been made until now. One scene of them is for the evaluation of MSR antenna pattern and the influence of land radiation on antenna temperature was found to remain as far as about 600 km and 500 km from land at 23.8 GHz and 31.4 GHz, respectively. The other scenes were used for validation of retrieved water vapor content. The water vapor contents retrieved from MSR antenna temperatures were compared with the water vapor contents calculated from the radiosonde data at Chichijima and Minami Daitojima under a fine weather condition. As the result, the discrepancy between the retrieved and calculated ones was found throughout all data and every season. The MSR derived water vapor contents were always larger than the calculated ones by about 10 kg/sq m. The comparison between MSR antenna temperature and the brightness temperature calculated from radiosonde data was also made at 23.8 GHz and 31.4 GHz. The antenna temperatures measured at 23.8 GHz were larger than the calculated brightness temperatures. The causes of these discrepancies may be considered as follows: (1) the error of antenna pattern correction; (2) the increase of brightness temperature due to surface roughness of the sea; (3) the error of theoretical atmospheric attenuation; (4) measurement errors of the MSR; and (5) the time difference between the MSR and radiosonde observations.

Author (NASDA)

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ESTIMATION OF MTF OF MOS-1 MESSR IMAGES

TOSHIBUMI SAKATA, HARUHISA SHIMODA, and KIYONARI FUKUE /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 103-114 Dec. 1988 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Japan

Avail: CASI HC A03/MF A04

An MTF (Modulation Transfer Function) of MESSR (Multispectral Electronic Self-Scanning Radiometer) image was estimated using an edge spectrum ratio method. This method is based on the Fourier spectrum amplitude ratio between the real and an ideal edge through a Hanning window. This method was applied to vertical and horizontal edges in several MESSR images. As the values of the Effective Instantaneous Field of View (EIFOV), 81 and 67 m were obtained from the estimated MTF for tracking and scanning directions, respectively. Furthermore, the estimated line spread function from the obtained MTFs showed that the half value width are 52 and 46 m for that two directions, respectively.

Author (NASDA)

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GEOMETRICAL CORRECTION FOR MOS-1 MESSR AND VTIR IMAGE DATA

TAKASHI HOSHI (Tsukuba Univ. (Japan).), YOSHIFUMI

SAMESHIMA (Tsukuba Univ. (Japan).), and KOREHIRO MAEDA (National Space Development Agency, Saitama, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 115-119 Dec. 1988
 Avail: CASI HC A01/MF A04

The purpose of this research is to rectify the geometric distortions included in the original image data to enable the analysis using image data of MOS-1 (Marine Observation Satellite-1). The image data used in this research are extracted from MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) loaded on the platform of MOS-1. The data are not rectified yet. The evaluation of the results obtained from this research is carried out from GCP (Ground Control Point) and distance points of view. Author (NASDA)

N92-22883# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION

MASAO TAKABE, TOSHIKAZU ITABE, and TADASHI ARUGA *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 120-130 Dec. 1988 *In* JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A04

An earth laser beacon is observed from space as a point similar to a bright star. Thus the spot image of laser beacon is very useful for calibration and correction of the earth's surface image taken by optical radiometers or cameras, since it corresponds to an infinitively small land mark which absolute location and brightness are known precisely. The experiments of tracking the MOS-1 (Marine Observation Satellite-1) and transmitting a laser beam from a ground station to the satellite have been conducted. Currently argon ion laser is used as a beacon and images taken by the MESSR (Multispectral Electronic Self-Scanning Radiometer) are analyzed for this study. In the near future, the use of CO₂ laser for the VTIR (Visible and Thermal Infrared Radiometer) will be tried. Author (NASDA)

N92-22884# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

INVESTIGATION ON COLOR COMPOSITES OF MESSR, VTIR, AND MSR DATA

TAKUJI MIWA, YUICHI ASAHI, and TAKASI IKEDA *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 131-139 Dec. 1988 *In* JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

The purpose of this report is establishment of a method for suitable expression of MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data on B/W (Black and White) and color photosensitive materials, and selection of useful band combinations, color sequences and transfer functions. In this report, MESSR data of two scenes are used. On the first scene, the suitable band combinations and color sequences are examined using color composites made from B/W negative films which are prepared by NASDA (National Space Development Agency of Japan) EOC (Earth Observation Center). On the second scene, B/W images of MESSR and TM (Thematic Mapper) data are made from CCT (Computer Compatible Tape) using the suitable transfer functions, and the influence to visual interpretation are examined on these images. TM images are made from the averages of four pixels to adjust resolution. It is shown that the histograms of the two scene data are narrow and the images of good gradation suitable for visual interpretation can not be obtained. Author (NASDA)

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VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR AND VTIR DATA IN THE FIELD OF DISASTER PREVENTION

SHIGETSUGU UEHARA, SHINOBU YAZAKI, TOSHIKAZU MOROHOSHI, SHINICHI KISHI, HIROSHI OHKURA, and TEIJI

KUMAGAI *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 140-155 Dec. 1988
 Avail: CASI HC A03/MF A04

To verify the effectiveness of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) for classification of various objects, spectral characteristics of MOS-1 MESSR data taken on December 3, 1987 were compared with simultaneously observed airborne MESSR data and ground based spectrometer data in the NRCDP (National Research Center for Disaster Prevention) site area. Due to the great differences in ground resolution and in sensor gain mode, the adequate verification was very difficult. To verify the effectiveness of MOS-1 VTIR (Visible and Thermal Infrared Radiometer) data for the estimation of Sea Surface Temperature (SST), correlation ship between truth SST's and VTIR data on December 2-4, 1987 and January 23, 24, and 28, 1988, were analyzed. Since the number of truth SST data of January is larger than that of December, the analyses were done at first for the data of January and the results obtained were verified for the data of December. Through this study, findings are as follows. VTIR Band 3 and 4 data show fairly good correlation ship with truth SST's, but the Band 3 is better than the Band 4. Further, the Band 1 and 2 data also together with the Band 3 and 4 data can be used for more accurate SST estimation. Author (NASDA)

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A SURVEY ON LANDSLIDES AND VEGETATION IN MOUNTAIN DISTRICTS BY USING MESSR Report No. 2

HAJIME NISHIKAWA (Takuma Research and Development Co. Ltd., Dojima (Japan).), YASUO FUJII (Takuma Research and Development Co. Ltd., Dojima (Japan).), SHIGERU FUKUYAMA (Takuma Research and Development Co. Ltd., Dojima (Japan).), TAKAKAZU MARUYASU (Takuma Research and Development Co. Ltd., Dojima (Japan).), and SOTARO TANAKA (Remote Sensing Technology Center, Tokyo, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 156-159 Dec. 1988 *In* JAPANESE; ENGLISH summary
 Avail: CASI HC A01/MF A04

This paper describes an investigation of vegetation in mountainous district by using MESSR (Multispectral Electronic Self-Scanning Radiometer). The vegetation of Karasugawa River watershed have been investigated by using MESSR data which were obtained on May 31, 1987. And this time was an opportunity to have fine data of Karasugawa River watershed on October 14, 1987. The season of the data was autumn and the false color image shows various color in mountainous area correlated to the condition of vegetation. The condition of vegetation was analyzed and the forest type was classified by image processing using the MOS-1 (Marine Observation Satellite-1) data. Author (NASDA)

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EVALUATION OF MOS DATA FOR FOREST RESOURCE INVENTORY

HARUO SAWADA, YOSHIO AWAYA, ITSUHIITO OHNUKI, KAZUHIKO KOGLI, and FUMITOSHI TAKAHASHI *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 160-164 Dec. 1988 *In* JAPANESE; ENGLISH summary
 Avail: CASI HC A01/MF A04

Spectral characteristics of a MESSR (Multispectral Electronic Self-Scanning Radiometer) image were studied through a comparison with a LANDSAT MSS (Multi Spectral Scanner) image. Correlation of digital numbers between two entire images were high in visible channels (0.71 to 0.78) and in infrared channels (0.77 to 0.78). Four principal items of forest (DBH (Diameter at Breast Height), stand height, number of trees/hectare, and volume/hectare) were used for a canonical correlation analysis with MESSR data. By this analysis, infrared channels of MESSR were known to give important data for estimating forest biomass as those of MSS. Two images of VTIR (Visible and Thermal Infrared

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Radiometer) were overlaid and a simple method for creating a cloud free image was considered. Basic statistical values of the generated image were obtained. Author (NASDA)

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VERIFICATION OF RADIOMETRIC CHARACTERISTICS OF MESSR DATA AND VTIR THERMAL INFRARED DATA

YUKIO MUKAI, SHOJI TAKEUCHI, KAZUO WATANABE, YASUNORI NAKAYAMA, HIROSHI KIMURA, and MITSUNORI YOSHIMURA /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 165-183 Dec. 1988
Avail: CASI HC A03/MF A04

The following three characteristics were investigated: (1) Radiometric characteristics of MESSR (Multispectral Electronic Self-Scanning Radiometer); (2) Observation characteristics of water surface temperature by VTIR (Visible and Thermal Infrared Radiometer); (3) Land cover classification characteristics of MESSR. As for the radiometric characteristics of MESSR, four kinds of ground targets of different reflectances of bare soil, grass field, asphalt and water were selected. Irradiance and the spectral reflectances of the ground targets were measured at the same time of MOS-1 (Marine Observation Satellite-1) overpass, and the theoretical radiance of the ground targets observed by MESSR were estimated from the ground truth data. On the other hand, the actual radiances of the ground targets observed by MESSR were computed by examining the gray values of the ground targets in MESSR image and transforming them into radiances. Both the theoretical and actual radiances were compared and they were nearly equal in all bands. As for water surface temperatures observation characteristics, VTIR data were compared with NOAA and TM (Thematic Mapper) data obtained on the same day. Water surface temperatures derived from VTIR corresponded pretty well with those derived from NOAA but not with those from TM. As for land cover classification characteristics of MESSR, a test site was selected and a land cover classification images of the test site were produced using MESSR, LANDSAT MSS (Multi Spectral Scanner) and TM data. The land cover classification characteristics of MESSR was investigated by comparing with the classified results by MSS and TM. Author (NASDA)

N92-22889# Tokyo Univ. (Japan). Inst. of Industrial Science.

SNOW OBSERVATION BY MOS-1, MSR AND VTIR

KATUMI MUSIAKE (Tokyo Univ., Tanashi (Japan).) and TOSIO KOIKE (Nagaoka Technological Univ., Niigata, Japan) /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 184-186 Dec. 1988
Avail: CASI HC A01/MF A04

Synchronizing the implementation of the MOS-1 (Marine Observation Satellite-1) Verification Program, ground truth data for MSR (Microwave Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) were obtained around Asahikawa in February 1988. Snow surface temperature, snow depth, and snow density were observed along the route of the aircraft from Mt. Asahidake to Biei and snow depth at 48 sites were collected around Asahikawa. The distribution of the physical characteristics of snow around Asahikawa is identified and it is compared with the data of MSR and VTIR from MOS-1 and the aircraft.

Author (NASDA)

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STUDY ON SNOW HYDROLOGY THROUGH APPLICATION OF MOS-1 SATELLITE DATA

KENJI ISHIHARA (Environmental Research and Technology Inst., Tokyo (Japan).), TATSUO IZAWA (Environmental Research and Technology Inst., Tokyo (Japan).), MASAOMI AKAGAWA (Environmental Research and Technology Inst., Tokyo (Japan).), KIYOSHI TSUCHIYA (Chiba Univ. (Japan).), TAKASHI ISHIYAMA (Chiba Univ. (Japan).), MASAO MATSUMOTO (Chiba Univ. (Japan).), KAZUO WATANABE (Remote Sensing Technology Center, Tokyo (Japan).), and KATSUTOSHI KOZAI (Kobe Univ. of Mercantile Marine, Japan) /In NASDA, Proceedings of the Second

Symposium on MOS-1 Verification Program p 187-211 Dec. 1988

Avail: CASI HC A03/MF A04

Snow cover in Hokkaido, Japan was studied, using MOS-1 (Marine Observation Satellite-1) satellite data. Starting with the first snow cover on Mt. Daisetsu to Tokachi Mountain range during the pre-snowy season, snow cover in both the mountain range and plain during the snowy season, and snow lines extending from both sides of the upstream of Ishikari River down to Ishikari Plain during the snow melt season, are detected by MESSR (Multispectral Electronic Self Scanning Radiometer) images. From analysis of MESSR MT (Magnetic Tape) data, it is shown that the seasonal change of the incidence (mW/sq cm/str) at Bands 1 and 4 differ depending upon urban district and vegetation (bamboo grass and pine communities). Analysis of VTIR MT data indicates that the brightness temperature of the snow surface is high along the upstream of Tokachi River in the western and Ribetsu River in the eastern parts and low along Otofuke River in the central part of the MESSR imagery. Finally, from the analysis of MSR (Microwaver Scanning Radiometer) MT data, it is shown that MSR brightness temperature (K) are negatively correlated in shallow snow, while in deep snow there is no correlation between them.

Author (NASDA)

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OBSERVATION OF DRIFT ICE AND SALT FIELD IN THE LIAODONG BAY, CHINA BY MOS1/MESSR

SUMITOSHI OGATA /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 212-219 Dec. 1988

Avail: CASI HC A02/MF A04

NOAA/AVHRR (Advanced Very High Resolution Radiometer) and MOS-1/MESSR (Marine Observation Satellite-1 Multispectral Electronic Self-Scanning Radiometer) data can be supplementary to each other. In this preliminary test, MESSR data were used to make up for the rough spatial resolution of AVHRR time series data. It has been found that MESSR's spatial resolution is sufficient enough to observe the early stage of drift ice generation and classify salt fields. Author (NASDA)

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ESTIMATION OF WAVES AND WINDS OVER SEAS IN THE COASTAL ZONE

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Avail: CASI HC A03/MF A04

A method with which quantitative informations of ocean waves and sea surface winds are obtained from an imagery of visible bands of MESSR (Multispectral Electronic Self-Scanning Radiometer) is discussed. Discrimination of the pattern of individual waves from a MESSR imagery is difficult because of low resolution of 50 m, while it is almost impossible from an image of TM (Thematic Mapper) or SPOT. There is, however, another approach to obtain the informations from a MESSR image. A population density of white caps generated by wave breaking increases with increasing wind speeds. A high density of the white caps over the sea surface will be reflected on the MESSR imagery as a bright spot which can be detected. In fact, a correlation is found between densities of high brightness over a sea area and wind speeds over it. It can be concluded that wind speeds can be estimated from MESSR images with considerations on the fetch and duration.

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Feasibilities of an wind estimation from MSR (Microwave Scanning Radiometer), which was our first subject, remain unsolved.

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ADVANCEMENT OF SEA SURVEY AND OBSERVATION TECHNIQUE IN THE SEA AROUND POWER PLANTS

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Avail: CASI HC A03/MF A04

Studies were carried out on the estimated physical precision of oceanic observations by an MESSR (Multispectral Electronic Self-Scanning Radiometer) and an MSR (Microwave Scanning Radiometer) mounted on the satellite MOS-1 (Marine Observation Satellite-1). For the MESSR, an analysis was conducted on the results of marine observations in Tokyo Bay synchronized with the satellite and the MSS (Multi Spectral Scanner) data from aircraft, to verify the validity of observations of various water-quality items. As a result, it was recognized that the MESSR Band 2 data was strongly correlated with chlorophyll-a, SS (Suspended Solid) and transparency. Regarding MSR data, an image analysis considering geometric correction, etc. was conducted, and the correlation between the MSR data and the data given by Buoy No. 6 of the Meteorological Agency was discussed. Also, sea-truth concerning waves and sea wind, and wave observation with the X-Band radar were carried out in the coastal area of Niigata Prefecture. The MSR data was more strongly correlated with the amount of water vapor rather than with sea wind and waves. The image of the X-Band radar (10 GHz) was strongly correlated with sea wind.

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N92-22894# National Aerospace Lab., Tokyo (Japan).

A STUDY ON INFORMATION ANALYSIS AIDS SYSTEM FOR SEA SURFACE TEMPERATURE MAPS

HAJIME KOSHISHI (National Aerospace Lab., Tokyo (Japan).), MASAO NAKA (National Aerospace Lab., Tokyo (Japan).), HIROMICHI YAMAMOTO (National Aerospace Lab., Tokyo (Japan).), KOHTARO MATSUMOTO (National Aerospace Lab., Tokyo (Japan).), KOHZO HOMMA (National Aerospace Lab., Tokyo (Japan).), SATSUKI MATSUMURA (Japan Fisheries Information Service Center, Tokyo.), HIDEO TAKAHASHI (Japan Fisheries Information Service Center, Tokyo.), SATORU NAKAMURA (Japan Fisheries Information Service Center, Tokyo.), HIDEO TAMEISHI (Japan Fisheries Information Service Center, Tokyo.), YOSHIIHIRO OKADA (Japan Fisheries Information Service Center, Tokyo.) et al. *In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 249-254 Dec. 1988*

Avail: CASI HC A02/MF A04

Oceanic conditions such as fronts, ocean currents, eddies, etc. are very useful for fisheries. For extracting these oceanic conditions, accumulated knowledge and inherited experience are indispensable, and simplified processing and high accuracy of the processed results are important. Technology of knowledge based processing is expected to be applicable to these problems. A feasibility study on information analysis aids for Sea Surface Temperature (SST) image data using this technology was performed. This paper also describes implementation of a prototype knowledge based system.

Author (NASDA)

N92-22895# Kanazawa Inst. of Tech. (Japan). Lab. of Information Science.

THE ESTIMATION OF ATMOSPHERIC SCATTERING AND TOPOGRAPHIC EFFECTS ON THE MOS-1 IMAGERY

YOSHIYUKI KAWATA and TAKASHI KUSAKA *In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 255-262 Dec. 1988*

Avail: CASI HC A02/MF A04

The main object of this study is to estimate both the atmospheric scattering and topographic effects on the image data measured by the MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer). In this preliminary report, the basic algorithm which converts the measured satellite-level radiance data into the ground albedo data in a flat terrain case are presented. In the analysis, the values of relevant atmospheric parameters such as the optical thickness, the single scattering albedo, and the turbidity factor of the atmosphere were adopted from a model atmosphere given by LOWTRAN 6 code in the evaluation of scattering and transmission functions. Lambert's law was assumed as a bidirectional reflection at the ground surface.

Author (NASDA)

N92-22896# National Inst. for Environmental Studies, Tsukuba (Japan).

EVALUATION OF ATMOSPHERIC EFFECT ON MULTISPECTRAL ELECTRONIC SELF-SCANNING RADIOMETER (MESSR) DATA BY SPECTRAL MEASUREMENT

YOSHIFUMI YASUOKA, TADAKUNI MIYAZAKI, YASUHIRO SASANO, and SACHIKO HAYASHIDA *In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 263-272 Dec. 1988*

Avail: CASI HC A02/MF A04

Atmospheric parameters were estimated by three different methods to evaluate the atmospheric effect on the MESSR (Multispectral Electronic Self-Scanning Radiometer) data. The atmospheric transmittance and the path radiance were estimated from a set of radiance data which are the upwelling radiance measured above water surface and the radiance detected by the MESSR at the corresponding points. Also, the transmittance was estimated from the measurement of direct solar radiation. Further, the transmittance was estimated from the laser radar data.

Author (NASDA)

N92-22897# Institute of Physical and Chemical Research, Saitama (Japan).

RETRIEVAL OF WATER QUALITY PARAMETERS FROM RADIANCE DETECTED BY MESSR

SHIGEHICO SUGIHARA and MOTOAKI KISHINO *In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 273-278 Dec. 1988*

Avail: CASI HC A02/MF A04

In general, it is rather difficult to estimate the water quality parameters such as the chlorophyll concentration in the surface water from the radiance collected by the MESSR (Multispectral Electronic Self-Scanning Radiometer) of MOS-1 (Marine Observation Satellite-1) since the CCT (Computer Compatible Tape) counts over the water are, in general, too small and path radiance, which has no information on water quality, enters into the sensor. For the water rich in phytoplankton, however, the radiance emerging from below the water surface is large and estimation of chlorophyll concentration might be possible. In order to test the possibility for estimating the water quality parameters in the Lake Kasumigaura from MOS-1 MESSR data, atmospheric transmittance and the sky radiance was observed on October 13, 1987 to estimate the path radiance. After the removal of the path radiance from the MESSR raw data, chlorophyll concentration was estimated.

Author (NASDA)

N92-22898# National Research Inst. for Pollution and Resources, Tokyo (Japan).

EVALUATION OF SPECTRAL RADIANCE OF INLAND SEA WATER IN MOS-1 MESSR IMAGES

MASAMITU ONITSUKA, KAZUYUKI OHTA, and TSUYOSHI SAMUKAWA *In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 279-283 Dec. 1988 In JAPANESE; ENGLISH summary*

Avail: CASI HC A01/MF A04

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An extraction method for water color by means of MOS-1 (Marine Observation Satellite-1) data set was studied. This method contained two major parts, the reducing of path radiance from the original data and decomposition from the upward intensities just above the sea surface to $x(\text{sub } 10)$, $y(\text{sub } 10)$, $z(\text{sub } 10)$ components. It was shown that the values of $x(\text{sub } 10)$, $y(\text{sub } 10)$, $z(\text{sub } 10)$ had the error of about 0.02 by standard light source calculations. From the MOS-1 data set, the water color for center part of Tokyo Bay was estimated with the set of values $x(\text{sub } 10) = 0.29$, $y(\text{sub } 10) = 0.33$, $z(\text{sub } 10) = 0.38$ which shown that the MOS-1 data set contained considerable parts of light reflected on the sea surface. Author (NASDA)

N92-22899# Tohoku Univ., Sendai (Japan). Dept. of Geophysics.

A COMPARISON OF SEA SURFACE TEMPERATURE DETECTED BY MOS-1/VTIR AND FERRIES, ISHIKARI AND OGASAWARA, AND DISCUSSION OF THE RESULTS FROM ASPECTS OF PHYSICAL OCEANOGRAPHY

HIROSHI KAWAMURA, KIMIO HANAWA, and YOSHIKI TOBA
/n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 284-288 Dec. 1988
Avail: CASI HC A01/MF A04

Sea Surface Temperature (SST) observed by MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) Band 3 and 4 (10.5-11.5 and 11.5-12.5 m in wavelength) is compared with in-situ data set of SST obtained by the ferries, Ishikari and Ogasawara. The former shuttles between Nagoya and Tomakomai via Sendai along the Pacific coast of Japan in four days, and the latter shuttles between Tokyo and Ogasawara across the Kuroshio in six days. The Level-2 data of VTIR obtained June 17, 1987 are analyzed and SST of VTIR at positions of the Ishikari around the time of MOS-1 passage are sampled. A brief comparison between SST observed by MOS-1 and by the Ishikari is made. This is the preliminary report of the study for MVP (MOS-1 Verification Program). Author (NASDA)

N92-22900# Nagasaki Univ. (Japan). Dept. of Civil Engineering.

EXPERIMENT OF ACCURACY OF LANDCOVER CLASSIFICATION AND SEA SURFACE TEMPERATURE ESTIMATION FROM MOS-1 DATA

KEINOSUKE GOTOH (Nagasaki Univ. (Japan).), MASATOSHI MORI (Kinki Univ., Fukuoka (Japan).), KAZUO KAWATATE (Kyushu Univ., Fukuoka (Japan).), MASAHIRO SETOJIMA (Kokusai Kogyo Co. Ltd., Tokyo (Japan).), and MASATSUNA KOGA (Japan Weather Association, Tokyo.) /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 289-293 Dec. 1988 In JAPANESE; ENGLISH summary
Avail: CASI HC A01/MF A04

The purpose of this experiment is to check the accuracy of landcover classification and sea surface temperature estimation from MOS-1 (Marine Observation Satellite-1) data. This report deals with the efficiency of both MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) sensors in the sea area. The following two cases are analyzed: (1) to detect the ground water springing into the sea around the Shimabara Peninsula in Kyushu, Japan; and (2) to detect snow water of the Ishikari River flowing into the Ishikari Bay in Hokkaido, Japan. In the latter case, the snow-covered area is also detected in order to check the efficiency of VTIR sensor in the land area. Author (NASDA)

N92-22901# Toba Merchant Marine Coll. (Japan).

APPLICABILITY OF MESSR AND VTIR DATA FOR MARINE OBSERVATION

HIROAKI OCHIAI /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 294-301 Dec. 1988

Avail: CASI HC A02/MF A04

Using the data obtained by MOS-1 (Marine Observation Satellite-1), an attempt was made to evaluate the applicability of remote sensing for marine environment, and the results are as

follows: (1) the boundary of river water from Ibi and Kiso River is well defined by the MESSR (Multispectral Electronic Self-Scanning Radiometer) data during the cold season; (2) the water characteristics in the area of red tide recognized by ship's observation in Ise Bay are not well defined by MESSR data in the 1 Jun. 1987 case; and (3) the discontinuous front off the mouth of Ise Bay is well indicated by VTIR (Visible and Thermal Infrared Radiometer) data, especially thermal band imagery on 24 Jul. 1987.

Author (NASDA)

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MOS-1 DATA BEING ENROLLED IN TO THE KUROSHIO EDDY OBSERVATION SYSTEM

TSUKASA NISHIMURA (Tokyo Univ. (Japan).), SOTARO TANAKA (Tokyo Univ. (Japan).), TOSHIRO SUGIMURA (Tokyo Univ. (Japan).), and YUJI HATAKEYAMA (Asia Air Survey Co. Ltd., Suita, Japan) /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 302-312 Dec. 1988
Avail: CASI HC A03/MF A04

In the first half of 1980, the 'coherent structure of the Kuroshio' was detected by satellite remote sensing. In this experiment, an attempt was made to use the MOS-1 (Marine Observation Satellite-1) data in the Kuroshio Eddy Observation System, a pilot system. The system design is based on the 'multi-concept', a basic concept of remote sensing. Four types of data are linked and synthesized under the 'coherent structure concept', a deterministic view of the 'turbulence'. Through operation of this pilot system, insight into the mechanics of the dynamic behavior of the coherent structure has been gained, and qualitative estimates of its effects on the Kuroshio variability have been made. The daily monitoring of the 'coherent structure' was determined to be the main task of the operation phase of Kuroshio Eddy Observation System. In this MOS-1 verification experiment, application of the VTIR (Visible and Thermal Infrared Radiometer) data to the daily monitoring of the coherent structure was examined, and the design concept required in the operation phase Marine Observation Satellite is discussed. Author (NASDA)

N92-22903# Science Univ. of Tokyo, Chiba (Japan). Dept. of Civil Engineering.

ADAPTABILITY OF MOS-1 DATA TO VISUALIZATION OF COASTAL HYDRAULIC PHENOMENA

SOTOAKI ONISHI, TAKEHARU OHURA, and JAP TSAREN /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 313-317 Dec. 1988
Avail: CASI HC A01/MF A04

Hydraulic behavior of effluents dumped into the Sea of Japan at the northern coast of Honshu Island in Japan from rivers and plants are studied through the satellite remote sensings from the MOS-1 (Marine Observation Satellite-1) and LANDSAT together with ship-borne measurements. Those behaviors can be clearly visualized through differences of water temperature and turbidity, using the data obtained by the MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), MSS (Multi Spectral Scanner), and TM (Thematic Mapper). The ship-borne measurements show that the movement of the coast water along the shoreline changes its direction mainly due to tide. Through the satellite remote sensing it can be shown how these effluents far offshore may be affected by the oceanic current and become to have geostrophic nature at fields extremely far off the exits. Author (NASDA)

N92-22904# Hiroshima Inst. of Tech. (Japan).

COASTAL ENVIRONMENTAL MONITORING BY MOS-1 MESSR DATA

YUZO SUGA /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 318-325 Dec. 1988 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A04

This study deals problems encountered in acquiring the coastal environmental information from MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data. In the sea-truth experiment, the water quality

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parameter analysis was performed to monitor the water pollution in Hiroshima Bay, simultaneously with MOS-1 observation. Coastal environmental information could be obtained by each single band level slice, the categorization of the maximum likelihood method, and by the principal component analysis. Author (NASDA)

N92-22905# Toyama National Coll. of Maritime Technology, Shinminato (Japan).

CASE STUDIES OF EARTH SURFACE OBSERVATION USING MOS-1. 1: COLOR OF SEA AND TRANSPARENCY. 2: SST. 3: ACTUAL VEGETATION

SHIGEKI ISHIMORI (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), MASASHI KAWAI (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), TAKASHI MACHIMURA (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), NORIHISA KAMIBAYASHI (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), and HIROSHI WAKABAYASHI (Toyama Prefectural Fishery Experimental Station, Namerikawa, Japan) /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 326-335 Dec. 1988

Avail: CASI HC A02/MF A04

The availability of earth surface observation using MOS-1 (Marine Observation Satellite-1) data was studied. The extent to which the MESSR (Multispectral Electronic Self-Scanning Radiometer) data explains the color of sea and transparency is addressed. In order to examine these relations, MESSR data were combined with in situ data by employing simple statistical methods. Experimental and theoretical algorithms were developed to derive SST (Sea Surface Temperature) using two thermal infrared bands of VTIR (Visible and Thermal Infrared Radiometer). The accuracy was investigated by comparing with SST's measured by ships and buoys. The feasibility of actual vegetation identification was examined with MESSR data. In this study, black and white aerial photographs were utilized as a ground reference.

Author (NASDA)

N92-22906# Japan Fisheries Information Service Center, Tokyo.

APPLICATION OF MOS-1 DATA FOR SKIPJACK FISHING GROUND FORECAST

HIDEO TAMEISHI, OSAMU HONDA, YOSHIHIRO OKADA, and TOSHIYUKI KOGUCHI /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 336-350 Dec. 1988 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A04

The application of data collected by the Visible and Thermal Infrared Radiometer (VTIR), onboard the Marine Observation Satellite-1 (MOS-1), to the fishing industry is important from a utilitarian point of view. Presently, it is useful to forecast the supply of the fishing grounds in shortage periods. However, in the past, the forecasting of fish supplies during shortages has depended upon the fisherman's intuition and experience. Using this plan, it is difficult to operate efficiently, at low cost, and according to plan. This study investigates the use of VTIR data in the forecast of fish supplies. The results may encourage the fishing industry to take advantage of VTIR data. Author (NASDA)

N92-22907# Tokyo Univ. (Japan). Ocean Research Inst. **ON THE MEASUREMENT OF THE UNDERWATER AMBIENT NOISE BY MOS-1 DCS**

JIRO SEGAWA (Tokyo Univ. (Japan).), HIROMI FUJIMOTO (Tokyo Univ. of Fisheries, Japan), and TOSHIHARU KAKIHARA /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 351-405 Dec. 1988

Avail: CASI HC A04/MF A04

In order to verify the performance of the Marine Observation Satellite-1 (MOS-1) Data Collection System (DCS), a buoy system with hydrophones that measure the underwater acoustic ambient noise was developed. In this report, the concept of this buoy system is reported. The measurement of the ambient noise is made by a conventional method with the hydrophones grounded at the sea floor or suspended from a vessel. A system which can

measure noise with the help of hydrophones attached to a signal cable and suspended from a drifting buoy on the sea surface is suggested.

Author (NASDA)

N92-22908# Meteorological Satellite Center, Tokyo (Japan).

ESTIMATION OF CLOUD PARAMETERS USING

MULTI-CHANNEL DATA Report No. 2

AKIYOSHI MITA, MASAMI TOKUNO, KAZUhide YAMAMOTO, and KAZUO SEKINE /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 406-415 Dec. 1988 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A04

Cloud analysis was performed by using the Marine Observation Satellite's (MOS's) Visible and Thermal Infrared Radiometer (VTIR), Multispectral Electronic Self-Scanning Radiometer (MESSR), and Microwave Scanning Radiometer (MSR) data in Jul. 1987. For VTIR data, discriminant analysis of cloud types was carried out and reasonable results were obtained. For MESSR data, the brightness levels of cloud areas were analyzed, and some features present in the cloud images were investigated for MSR data. The high spatial resolution of MESSR shows the fine structure of clouds, while MSR seems to be effective at discerning precipitating clouds.

Author (NASDA)

N92-22909# Tokai Univ., Shizuoka (Japan). Faculty of Marine Science and Technology.

STUDY OF ATMOSPHERIC CORRECTION FOR THE APPLICATION OF MOS-1/MESSR TO OCEANOGRAPHY

YASUHIRO SUGIMORI, NIROO NATSUME, MASATOSHI AKIYAMA, and SHIN FUJITA /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 416-434 Dec. 1988

Avail: CASI HC A03/MF A04

In order to determine the properties of sub-surface ocean water, the Marine Observation Satellite-1 Multispectral Electronic Self-Scanning Radiometer (MOS-1/MESSR) spectrally analyzed the radiance of upwelling water. The tentative development of an atmospheric correction algorithm for the MOS-1/MESSR, using a model originally developed for the NIMBUS-7/Coastal Zone Color Scanner, is reported.

Author (NASDA)

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MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR

YUJI OHSAKI (Ministry of Posts and Telecommunications, Kashima (Japan).) and MASAHARU FUJITA (Radio Research Labs., Tokyo, Japan) /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 435-446 Dec. 1988

Avail: CASI HC A03/MF A04

The feasibility of microwave remote sensing of rain by using the Marine Observation Satellite's (MOS's) Microwave Scanning Radiometer (MSR) was examined as a part of the MOS validation program conducted by the National Space Development Agency of Japan (NASDA). Good agreement was found between the MSR brightness temperature map and the rain rate distribution measured by radar. This indicates a promising future of MOS's MSR for rain delineation. Rain rate estimation algorithms that use brightness temperature or excess brightness temperature to estimate rain rates, are examined by comparison with radar rain rates.

Author (NASDA)

N92-22911# University of Electro-Communications, Tokyo (Japan).

IMPROVING ON ACCURACY OF PHYSICAL PARAMETER ESTIMATED BY MOS-1 MSR: EFFECT OF THE ANTENNA PATTERN

TSUTOMU SUZUKI, IKUO ARAI, MAKOTO KAJI, and KAZUHIKO MORITA /n NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 447-451 Dec. 1988 In JAPANESE; ENGLISH summary

Avail: CASI HC A01/MF A04

The accuracy of sea surface temperature data, as measured

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by the Marine Observation Satellite's (MOS's) Microwave Scanning Radiometer (MSR), was degraded by antenna scanning in the antenna sidelobes and the rotation of the polarization. A data correction technique that can improve the accuracy is discussed. In order to improve the accuracy, an inverse filtering process was used on the data. The result shows a marked improvement in the resolution of the temperature profile. Author (NASDA)

N92-22912# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanographic Div.

UTILIZATION OF SATELLITE IMAGES FOR MARINE RESOURCES

DENZO INAGAKE and AKIRA TOMOSADA /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 452-464 Dec. 1988

Avail: CASI HC A03/MF A04

Some small scale sea surface phenomena, such as streamers, warm tongues, frontal eddies, etc., are detected by satellite images. Since these phenomena are believed to be related to the concentration and distribution or movement of fish schools, it was attempted to clarify the relationship between the structures and fisheries. The sea truth data were acquired during the Marine Observation Satellite-1 (MOS-1) Verification Program on 5-8 Aug. and 3-5 Dec. 1987. Additionally, a warm tongue near the Kuroshio warm-core ring was observed onboard the Soyo Maru in Sep. 1987. The warm tongue's structure was located from the sea surface to a depth of 300 m. This suggests that the small scale phenomena identified in satellite images not only really exist, but, also have structures to a considerable depth. It is considered that these phenomena are important for the distribution of fish schools and its fluctuations or migrations. The mechanism of concentration in fish schools at the purse seine fishing grounds southeast of Hokkaido Island is observed from infrared images and oceanographic observations from a research vessel conducted in summer of 1987. The possibility of estimating the size of the sardine schools by visible images is examined. Author (NASDA)

N92-22913# Chiba Univ. (Japan). Dept. of Electronic Engineering.

MOS-1 MESSR NOISE ANALYSIS

YOSHIZUMI YASUDA, HUA QI, and YASUFUMI EMORI /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 465-471 Dec. 1988

Avail: CASI HC A02/MF A04

A Charge Coupled Device (CCD) line sensor is used in the visible and near-infrared sensor Multispectral Electronic Self-Scanning Radiometer (MESSR) onboard the Marine Observation Satellite-1 (MOS-1) instead of the mirror scanning mechanism used in the LANDSAT Multi Spectral Scanner (MSS) and Thematic Mapper (TM). Images that were obtained by MOS-1 MESSR, LANDSAT TM, and SPOT-1 High Resolution Visible Instrument (HRVI) are analyzed to determine the noise pattern in each scanning system. Author (NASDA)

N92-22914# Chiba Univ. (Japan). Dept. of Electronic Engineering.

MOS-1 MESSR IMAGE-DRIVEN MTF

YOSHIZUMI YASUDA, HUA QI, and YASUFUMI EMORI /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 472-481 Dec. 1988 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A04

The method of edge-spectra division was used to drive the Modulation Transfer Functions (MTFs) of images scanned by Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self-Scanning Radiometer (MESSR), LANDSAT Thematic Mapper (TM), and SPOT-1 High Resolution Visible Instrument (HRVI) systems. A Hanning window was used before the Fourier transformation to avoid inaccuracy in computing the spectrum. The results indicate that the MOS-1 MESSR and SPOT-1 HRV, which use Charge Coupled Device (CCD) line sensors, have better spatial resolution than the LANDSAT TM which uses a mirror scanning mechanism. Author (NASDA)

N92-22915# Naruto Univ. of Education (Japan).

ELIMINATION OF SENSOR NOISE IN MOS-1 MESSR IMAGE

AKIRA KIKUCHI (Naruto Univ. of Education (Japan).), SHIGERU OMATSU (Tokushima Univ. (Japan).), TOSIO KITAMURA (Tokushima Univ. (Japan).), SHIGEKI ISAWA (Tokushima Univ. (Japan).), and MIKI OGURO (Tokushima Prefectural Fisheries Experimental Station, Naruto, Japan) /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 482-486 Dec. 1988

Avail: CASI HC A01/MF A04

When the sea quality is analyzed by using remotely sensed data, the low level multi-spectral data must be used. However, the data from the Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self-Scanning Radiometer (MESSR) contain period sensor noise and a smear phenomenon which are characteristics of the operation of a Charge Coupled Device (CCD). The sensor noise is analyzed using a Fast Fourier Transformation (FFT) technique in order to examine the frequency of the noise. Then, it is established that the period sensor noise occurs every 34 lines in the MESSR image. Finally, the sensor noise in the MESSR image is eliminated by using a Median Filter restoration procedure which can smooth the suddenly corrupted impulse noises. Author (NASDA)

N92-22916# Ministry of Construction (Japan). Coastal Engineering Div.

ESTIMATION OF RADIOMETRIC EFFICIENCY OF VTIR,

MESSR BASED ON SEA TRUTH DATA

TAKAAKI UDA, YOSHIMI MURAI, and TSUTOMU TAKEBUCHI /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 487-492 Dec. 1988 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A04

Diffusion of turbid water around the mouth of the Oi River was observed simultaneously using ships and Marine Observation Satellite-1 (MOS-1). It is found that Band 1 of the Multispectral Electronic Self-Scanning Radiometer (MESSR) data and turbidity were not directly correlated. Some data were affected by the presence of clouds, and therefore the brightness of MESSR data was overestimated. When corresponding data from Band 1 were removed, correlation between MESSR data and turbidity was improved. Author (NASDA)

N92-22917# Japan Weather Association, Tokyo.

COMPARISON OF MOS-1 VTIR DATA AND NOAA AVHRR DATA IN REFERENCE TO THERMAL AND SPATIAL RESOLUTION

MASATSUNA KOGA (Japan Weather Association, Tokyo.), SEI-ICHI SAITO (Japan Weather Association, Tokyo.), HIROSHI KOKAI (Japan Weather Association, Tokyo.), YOSHIZUMI YASUDA (Chiba Univ. (Japan).), KEINOSUKE GOTO (Shimizu System Inst., Hokkaido (Japan).), and MASAO SHIMIZU (Shimizu System Inst., Hokkaido, Japan) /In NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program p 493-497 Dec. 1988 In JAPANESE; ENGLISH summary

Avail: CASI HC A01/MF A04

Marine Observation Satellite-1 (MOS-1) Visible and Thermal Infrared Radiometer (VTIR) data is compared with NOAA-9 Advanced Very High Resolution Radiometer (AVHRR) data in terms of thermal and spatial resolution. Two data sets, which were gathered on 1 Jun. and 28 Oct. 1987, were evaluated. Both MOS-1 VTIR and NOAA-9 AVHRR data were gathered on each day. Initially, the Level 2 data of the MOS-1 VTIR were used and Level 0 data were not used. There was a time lag of five hours in data reception. Hence, the sea surface temperature is used for comparison because it can be assumed that the sea surface temperature remained approximately constant for the time period. The thermal resolution of MOS-1 VTIR Channel 3 is about 0.6 C.

Author (NASDA)

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N92-22976# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS OF THE THIRD SYMPOSIUM ON MOS-1 VERIFICATION PROGRAM (MVP), NO. 1

Mar. 1990 609 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 27 Feb. - 1 Mar. 1989 Original contains color illustrations

(JTN-92-80305) Avail: CASI HC A99/MF A06

The following topics were discussed: MOS-1 (Marine Observation Satellite-1) satellite, MOS-1 Verification Program, radiometers, MESSR (Multispectral Electronic Self-Scanning Radiometer), MSR (Microwave Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), remote sensing, remote sensors, spatial resolution, antenna radiation pattern, modulation transfer function, point spread function, radiometric characteristics, image processing, atmospheric correction, geometric correction, brightness temperature, radiance, correlated color temperature, radiances, sea surface temperature, timber identification, vegetation identification, snow cover identification, sea ice identification, landslide observation, cloud observation, land cover classification, and ocean currents observation.

Author (NASDA)

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OVERALL RESULTS OF MOS-1 VERIFICATION PROGRAM (MVP)

KOREHIRO MAEDA and HIDEO SATOH In its Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), no. 1 p 1-42 Mar. 1990

Avail: CASI HC A03/MF A06

The Marine Observation Satellite-1 (MOS-1), Japan's first earth observation satellite, was successfully launched by N-2 Launch Vehicle from Tanegashima Space Center, NASDA (National Space Development Agency of Japan) on February 19, 1987. MOS-1 has four mission instruments: MESSR (Multispectral Electronic Self-Scanning Radiometer); VTIR (Visible and Thermal Infrared Radiometer); and DCST (Data Collection System Transponder). MOS-1 is a multipurpose satellite which can observe ocean, land, and atmosphere in wavelengths covering visible, near-infrared, thermal infrared, and microwave. The main objectives of MOS-1 are to establish fundamental earth observation technology and to observe ocean, land, and atmosphere by three radiometers and collect ocean data by DCS (Data Collection System). In order to achieve the mission objectives, NASDA developed space and ground segments. In order to evaluate MOS-1 observation system from various points of view, NASDA planned the MOS-1 Verification Program (MVP) and conducted MVP in collaboration with domestic and foreign investigators. In this paper, the outline of MOS-1 project, the outline of activity of MVP, and overall results obtained during these two years are presented.

Author (NASDA)

N92-22978# Tokai Univ., Tokyo (Japan). Research and Information Center.

OUTLINE OF RESULTS IN MESSR WORKSHOP

HARUHISA SHIMODA In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 43-61 Mar. 1990

Avail: CASI HC A03/MF A06

The aim of this MESSR (Multispectral Electronic Self-Scanning Radiometer) Workshop is to clarify some aspects of MOS-1 (Marine Observation Satellite-1) Verification Program which largely depend upon the analysis algorithms. Three kinds of areas have been selected for the Workshop. They are: (1) atmospheric correction; (2) estimation of spatial resolution of MESSR; and (3) capability of MESSR data for land use classification. In the atmospheric correction study, several kinds of algorithms estimating atmospheric parameters (i.e., transmittance and path radiance) have been tested at the same test site with the aid of various kinds of ground truth data. In the study of ground resolution estimation of MESSR data, several MTF (Modulation Transfer Function) estimating algorithms as well as several kinds of interpolating algorithms have been tested. Further, influence of relative sensor velocity to MTF has

been clarified. In the study of land use classification, capability of MESSR data has been verified against the land use data verified by ground truth. Also, the capability of MESSR data has been compared with that of LANDSAT TM (Thematic Mapper).

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OUTLINE OF RESULTS IN VTIR WORKSHOP

KIYOSHI TSUCHIYA In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 62-71 Mar. 1990

Avail: CASI HC A02/MF A06

The VTIR (Visible and Thermal Infrared Radiometer) Working Group has made studies focussed on the following subjects: (1) radiative transfer algorithm; (2) retrieval of sea surface temperature; (3) application of water vapor channel data; and (4) calibration accuracy. The result of the study leads to the following conclusions: (1) the radiative transfer algorithm developed by the group has a high degree of accuracy which in turn could verify the accuracy of VTIR calibration; (2) atmospheric influence on channel 4 is larger than channel 3; (3) VTIR data are useful for obtaining sea surface temperature; (4) precipitable water may be obtained from water vapor and window channels data; (5) the following improvement are necessary, increase of quantum level from eight to ten bits and lowering the lower limit of water vapor channel to -80 C; and (6) addition of more window channels is desirable.

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OUTLINE OF RESULTS IN MSR WORKSHOP

TSUTOMU SUZUKI In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 72-87 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A06

Main objective of the workshop is first to evaluate the radiometric measurement accuracy of the physical parameters obtained by MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) entitled 'Observation of Atmospheric Water Vapor and Rain Rate and Observation of Land Snow and Sea Ice' by the regression method. In order to increase accuracy, it is necessary to analyze the errors included in the data of MSR and to correct them as the bias compensation. The second work, entitled 'The Evaluation of the Equivalent MSR Bias Error' is to find the equivalent bias value to be compensated. The final work, entitled 'MSR Antenna Pattern Correction by the Modified Inverse Filtering' is to correct the polarization and sidelobe error of MSR antenna. By referring to truth data, the observation error of the water vapor at Hachijo Island became less than 2.6 kg/sq m. Bias errors are estimated to be about 21 K at 23 GHz and 18 K at 31 GHz, respectively. It is the remarkable, that the modified inverse filtering method has been proved as the most effective and practical technique for the correction of the antenna sidelobe.

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STUDY ON THE ESTIMATION TECHNIQUES OF SPATIAL RESOLUTION CHARACTERISTICS FOR THE MESSR

HAJIME KOSHIISHI, MASAO NAKA, and KOHZO HOMMA In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 88-96 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan

Avail: CASI HC A02/MF A06

As part of MOS-1 (Marine Observation Satellite-1) Verification Program (MVP), the computational techniques for estimating spatial resolution characteristics of satellite-based optical image sensor systems have been studied. Two methods of estimating overall spatial resolution characteristics of image sensor system have been investigated; frequency domain method (Fourier transformation) and spatial domain method (spatial convolution). Several factors affecting estimation accuracy of the spatial characteristics are also

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investigated. An outline is presented of MOS-1 data analysis experiments for estimating spatial resolution characteristics of the MESSR (Multispectral Electronic Self-Scanning Radiometer) that include: subpixel data generation processing from multiple contiguous scan line data with slightly different phase of the step targets; and compensation processing for the degradation of sensor's spatial characteristics due to relative motion between platform (satellite) and ground scene. Some results are shown through the estimation experiments using some step targets in the Tokyo Bay of the MESSR CCT (Computer Compatible Tape) data for the PSF (Point Spread Function) and MTF (Modulation Transfer Function) characteristics of the MOS-1 MESSR.

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INVESTIGATION OF ATMOSPHERIC EFFECT TO MESSR, VTIR, AND MSR, AND OBSERVATIONS OF OCEANIC PHENOMENA USING MSR, PART 1

YOZO TAKAYAMA, SYOICHI KOINUMA, TSUTOM TAKASHIMA, and KAZUHIKO MASUDA In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 97-109 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan

Avail: CASI HC A03/MF A06

Performance of the Visible and Thermal Infrared Radiometer (VTIR) on MOS-1 (Marine Observation Satellite-1) in measuring radiation is verified by comparing the observed brightness temperature with that of computed from aerological data. The result shows VTIR is measuring radiation reasonably well. Estimated Sea Surface Temperatures (SST's) retrieved from VTIR by using different multichannel algorithms were compared. The method using the relation of the radiation emitted from sea surface and observed by VTIR gives better result, because of close approximation. A small contribution of water vapor absorption band to the obtain SST was found. Estimated SST has a RMS (root mean square) temperature difference of 0.7 C. From comparison of Band 2 data with water vapor distribution, a good correlation between water vapor density distribution at 300 mb pressure level, and the brightness temperature pattern was found.

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INVESTIGATION OF ATMOSPHERIC EFFECT ON MESSR, VTIR, AND MSR AND OBSERVATIONS OF THE OCEANIC PHENOMENA USING MSR, PART 2

AKIRA SHIBATA, YOSHIO SHINOHARA, KOJI UENO, and KENZO SHUTO In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 110-115 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan

Avail: CASI HC A02/MF A06

A Microwave Scanning Radiometer (MSR) which is loaded on the Marine Observation Satellite-1 (MOS-1) is shown to have the capability of observing accumulated water vapor over the ocean with observational RMS (root mean square) errors of about 2.6 kg/sq m. This observation using the MSR becomes worse in the case when it is raining at a rate of more than about 10 mm/hour, due to the scattering by large rain drops. The MSR is also shown to have the capability of observing the sea ice in the Sea of Okhotsk through clouds.

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EVALUATIONS OF THE MSR ANTENNA PATTERN AND RETRIEVAL ERROR OF WATER VAPOR CONTENT

TAKEYUKI OJIMA (Kogakuin Univ., Tokyo (Japan).), KOREHIRO MAEDA (Kogakuin Univ., Tokyo (Japan).), and HIDEO SATOH (National Space Development Agency, Saitama, Japan) In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 116-126 Mar. 1990 In

JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan
Avail: CASI HC A03/MF A06

Twenty scenes of Microwave Scanning Radiometer (MSR) data obtained during May 1987 through Feb. 1988 were processed into images of water vapor and cloud liquid contents, using a retrieval algorithm. The images were used to estimate the validity of the retrieved water vapor content and of the influence of land radiation on antenna temperature. Some bias error was found in the retrieved water vapor content by comparing with radiosondes. If all the bias errors involved in the retrieval algorithms are treated as equivalent measurement errors of the MSR antenna temperature, the equivalent bias errors in the antenna temperature were found to be 21.7 and 18.7 K at 23 and 31 GHz, respectively. After correcting all data for these bias errors, the error of the retrieved water vapor content was less than 8 percent in a root mean square sense. Possible error causes of the equivalent bias errors are discussed. The effect of land radiation through antenna sidelobes on the antenna temperatures taken over the ocean near the Japanese archipelago more than 200 km offshore was found to be correctable using a function of the offshore distance. Therefore, the data taken within 600 km offshore, which have been considered erroneous because of influence of land radiation, can be used as close as 200 km offshore.

Author (NASDA)

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ESTIMATION OF MTF OF MOS-1 MESSR IMAGES

TOSHIBUMI SAKATA, HARUHIISA SHIMODA, and KIYONARI FUKUE In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 127-146 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Saitama, Japan

Avail: CASI HC A03/MF A06

An MTF (Modulation Transfer Function) of an MESSR (Multispectral Electronic Self-Scanning Radiometer) image was estimated using an edge spectrum ratio method. This method is based on the Fourier spectrum amplitude ratio between the real and an ideal edge through a Hanning window. This method was applied to vertical and horizontal edges in several MESSR images, 77 and 72 m were obtained as the values of the Effective Instantaneous Field of View (EIFOV) from the estimated MTF for tracking and scanning directions, respectively. Furthermore, the estimated line spread function from the obtained MTF's showed that the half value widths are 74 and 69 m for that two directions, respectively.

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VERIFICATION OF RADIOMETRIC CHARACTERISTICS OF MESSR DATA AND VTIR THERMAL INFRARED DATA

YUKIO MUKAI, SHOJI TAKEUCHI, KAZUO WATANABE, YASUNORI NAKAYAMA, HIROSHI KIMURA, and MITSUNORI YOSHIMURA In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 147-167 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A06

Four kinds of ground targets of different reflectances of bare soil, grass field, asphalt, and water were selected to investigate the radiometric characteristics of MESSR (Multispectral Electronic Self-Scanning Radiometer). Irradiance and the spectral reflectances of the ground targets were measured at the same time of MOS-1 (Marine Observation Satellite-1) overpass, and the theoretical radiance of the ground targets observed by MESSR were estimated from the ground truth data. On the other hand, the actual radiances of the ground targets observed by MESSR were computed by examining the gray values of the ground targets in MESSR image and transforming them into radiances. Both the theoretical and actual radiances were compared and they were nearly equal in all bands. To investigate water surface temperature observation characteristics, VTIR (Visible and Thermal Infrared Radiometer) data were compared with NOAA and TM (Thematic Mapper) data obtained on the same days. Water surface temperatures derived

from VTIR corresponded pretty well with those derived from NOAA but not with those from TM. This is considered because there may be some problems in estimating surface temperatures from TM. To investigate land cover classification characteristics of MESSR, a test site was selected and a land cover classification images of the test site were produced using MESSR, LANDSAT MSS (Multi Spectral Scanner) and TM data, and SPOT HRV (High Resolution Visible) data. The land cover classification characteristics of MESSR was investigated by comparing with the classified results by LANDSAT MSS, TM, and SPOT HRV.

Author (NASDA)

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GEOMETRIC CORRECTION FOR IMAGE DATA FROM MESSR, VTIR, AND MSR SENSOR

TAKASHI HOSHI and YOSHIFUMI SAMESHIMA *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 168-171 Mar. 1990 In JAPANESE; ENGLISH summary*

Avail: CASI HC A01/MF A06

The purpose of this research is to rectify the geometric distortions included in the original image data in order to perform the analysis using image data of MOS-1 (Marine Observation Satellite-1). Each corrected image is corresponded to the suitable map projection. The image data used in this research are extracted from MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), and MSR (Microwave Scanning Radiometer) loaded on the platform of MOS-1. The data are not rectified yet. The evaluation of the results obtained from this research is carried out from the Ground Control Point (GCP) and distance points of view.

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GEOMETRICAL ACCURACY OF MESSR IMAGE

MINORU AKIYAMA, TAMIO SEKIGUCHI, KESAMI KOIDO, and HIDEKI SASAJIMA *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 172-176 Mar. 1990 In JAPANESE; ENGLISH summary*

Avail: CASI HC A01/MF A06

In order to estimate the geometrical accuracy of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) bulk processed data, which is the most commonly used in ordinary remote sensing analysis, some 30 Ground Control Points (GCP's) were used for obtaining transformation formulas and residuals after transformation. By using Helmert's transformation, it was confirmed that the pixel size was adjusted exactly to 50 m, and that there remained no systematic error, where RMS (Root Mean Square) error of residuals at the GPS's was around one pixel. Therefore, it is assured that film products of bulk processed data can be registered onto UTM (Universal Transverse Mercator) projected map without any rectification. As for the higher order polynomial transformation, only small improvements could be observed. The second order polynomial seems appropriate for fine geometric correction.

Author (NASDA)

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APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION

MASAO TAKABE, TOSHIKAZU ITABE, and TADASHI ARUGA *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 177-187 Mar. 1990 In JAPANESE; ENGLISH summary*

Avail: CASI HC A03/MF A06

An earth laser beacon is observed from space as a point similar to a bright star. Thus, the spot image of a laser beacon is very useful for calibration correction of the earth's surface image pictured by cameras and optical radiometers. This is because it corresponds to an infinitively small land mark whose absolute location and brightness are known precisely. The experiments tracking the MOS-1 (Marine Observation Satellite-1) and

transmitting a laser beam from a ground station to the satellite have been conducted. Currently, an argon ion laser is used as a beacon, and images taken by the MESSR (Multispectral Electronic Self-Scanning Radiometer) are analyzed. In analyzing the results, geometric errors were found in the MESSR earth images and the satellite's attitude was examined from two coordinate point of the laser spot and the scene center.

Author (NASDA)

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IMPROVEMENT OF PHYSICAL PARAMETER ACCURACY ON MSR: CORRECTION OF THE EFFECT OF MOS-1 MSR

ANTENNA SIDELOBES AND ROTATED POLARIZATION

KAZUHIKO MORITA, IKUO ARAI, and TSUTOMU SUZUKI *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 188-192 Mar. 1990 In JAPANESE; ENGLISH summary*

Avail: CASI HC A01/MF A06

The accuracy of the sea surface temperature measured by MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) has been degraded by the rotation of the polarization due to antenna scanning and by the antenna sidelobes. This paper describes data correcting methods for the rotated polarization and the antenna sidelobes. The first, a simple function to correct the polarization error due to the antenna scanning was introduced. Second, in order to improve the physical parameter accuracy, a modified inverse filtering was used to suppress the error due to antenna sidelobes in both simulation and real data obtained by MOS-1 MSR. The results show increasing in the accuracy of the temperature profile.

Author (NASDA)

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A SURVEY ON LANDSLIDES AND VEGETATION IN

MOUNTAIN DISTRICTS BY USING MESSR Report No. 3

HAJIME NISHIKAWA (Nihon Univ., Narashino (Japan).), YASUO FUJII (Nihon Univ., Narashino (Japan).), SHIGERU FUKUYAMA (Nihon Univ., Narashino (Japan).), TAKAKAZU MARUYASU (Science Univ. of Tokyo (Japan).), and SOTARO TANAKA (Remote Sensing Technology Center, Tokyo, Japan) *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 193-197 Mar. 1990 In JAPANESE; ENGLISH summary*

Avail: CASI HC A01/MF A06

This paper describes an investigation of vegetation in a mountainous district by using a MESSR (Multispectral Electronic Self-Scanning Radiometer). The vegetation of the Karasugawa River watershed have been investigated by using MESSR data which were obtained on May 31, 1987 and October 14, 1987. The difference of false color images of these data shows various conditions of the vegetation between spring and autumn. At this time, the condition of the vegetation was analyzed and the forest type was classified by processing the data at once. As a result, the characteristics of vegetation in the basin were obtained by the image processing.

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PERFORMANCE OF MESSR DATA FOR LANDCOVER CLASSIFICATION

TSUKASA HOSOMURA, RYOUJI YAMAGUCHI, YOSHIAKI MATSUMAE, KIYONARI FUKUE, HARUHISA SHIMODA, and TOSHIBUMI SAKATA *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 198-213 Mar. 1990 In JAPANESE; ENGLISH summary*

Avail: CASI HC A03/MF A06

In order to evaluate performance of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data for landcover classification, classification accuracies of MESSR data were compared to that of LANDSAT TM (Thematic Mapper) data. The classification accuracies were estimated quantitatively with the aid of digital land-cover/use test site data which covers the area about 2 km times 10 km. MESSR

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data showed lower mean classification accuracy than TM data. The reason for this low accuracy was studied with the aid of several simulations concerning the ground resolution, spectral resolution, and quantization resolution. As a result of this simulation, it is clarified that the lower classification accuracy of MESSR data is mainly based on the lower spectral resolution and decrease of quantized levels. Author (NASDA)

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DISTRIBUTION OF LANDSLIDE OCCURRENCE NEAR NAGANO-CITY OBTAINED FROM IMAGERY ANALYSIS OF MOS-1 DATA

HIROMU SIMA /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 214-221 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

Visible and near infrared bands of MOS-1 (Marine Observation Satellite-1) data are used in imagery analysis to make clear the characteristics of ground surface of the Naniwa region where land slides have often occurred in the past. The investigation covered an area 3.6 km in width and 4.8 km in length, divided into six by eight meshes, each of which consisted of 12 pixels and 12 lines (about 600 m by 600 m). The numerical pattern depicted by taking the mean value of ratio Band 3/Band 2 in each mesh is discussed. Accordingly, a kind of map may be drawn which represents equi-brightness interpolated on an assumption of linear relation between the two mean values. Landslide occurrence is recognized in any region having the relatively smaller values of Band 3/Band 2. It is ascertained by determining the average plane so as to satisfy the distribution of ratio Band 3/Band 2, using the two dimensional least square method. If any difference exists between the ratio Band 3/Band 2 and the average plane, a map representing 'residual' will be drawn. From a comparison of this map with the location of landslide, it is shown that its occurrence is almost limited on the contour lines showing the relatively smaller values of Band 3/Band 2. Development of erosion due to many small streams may cause a decrease in the stability of slope and bring about the failure of sub-soil. Author (NASDA)

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TEST STUDY OF LAND COVER CLASSIFICATION AND SPATIAL RESOLUTION FROM MESSR DATA

TAICHI OSHIMA, ATSUSHI RIKIMARU, MASAZUMI KONISHI, and KAZUO KINOSHITA /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 222-228 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

The land cover classification using multispectral data are often used for the analysis of remote sensing. This study describes the verification report in terms of the green spatial distribution and how the characteristic of contents of land cover classifications by MESSR (Multispectral Electronic Self-Scanning Radiometer) and TM (Thematic Mapper) data are related to the spatial resolution of sensors and spatial size of the land cover. Author (NASDA)

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ACCURACY OF SPECTRAL RADIANCE FOR URBAN LAND COVER ESTIMATED BY MOS-1/MESSR

AKIRA HOYANO /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 229-237 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

The purpose of this research is to discuss the accuracy of spectral radiance for urban land cover estimated by MOS-1/MESSR (Marine Observation Satellite-1 Multispectral Electronic Self-Scanning Radiometer) data. At first, simulated images were made from smoothing an airborne MESSR data with 0.38 x 1 m resolution. Spectral radiance of the MOS-1 image was compared with that of the simulated image. However, no strong correlation was recognized. Furthermore, the ratio of pure pixels for each category which is a component of urban land coverage in

MOS-1/MESSR image have been estimated by using the above simulated images. Author (NASDA)

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VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR AND VTIR IN THE FIELD OF DISASTER PREVENTION

SHIGETSUGU UEHARA, SHINOBU YAZAKI, TOSHIKAZU MOROHOSHI, SHINKICHI KISHI, and HIROSHI OHKURA /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 238-271 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A06

Five case studies for the Multispectral Electronic Self-Scanning Radiometer (MESSR) and two for the Visible and Thermal Infrared Radiometer (VTIR) were carried out. For the MESSR, the case studies were carried out as follows: (1) Detection and classification of volcanic products due to eruption; (2) Geomorphological classification for flooding; (3) Comparison of the spectral characteristics of ground covers with the ones of airborne MESSR and ground based spectrometer; (4) Detection of vegetation recovery from the damage due to accumulated volcanic products after five years from the volcanic disaster; and (5) Detection of landslide traces due to earthquake after four years. For the VTIR, the case studies were carried out as follows: (1) Estimation of atmospheric temperature on land; and (2) Estimation of sea surface temperature in winter season. In the case of MESSR (1), the result obtained with MESSR shows slightly better than the one with TM (Thematic Mapper). In the cases of MESSR (4) and (5), the analyses were done by combined use with MSS (Multi-Spectral Scanner) and TM data. The results indicate the effectiveness of MOS-1 (Marine Observation Satellite-1) MESSR. In the case of VTIR, the estimation of atmospheric temperature using Band 1, 3 and 4 data shows fairly good results, with about 1.3 C in RMS (Root Mean Square) of the errors. Author (NASDA)

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INVESTIGATION ON COLOR COMPOSITES OF MESSR, VTIR, AND MSR DATA

TAKUJI MIWA, YUICHI ASAHI, and TAKASHI IKEDA /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 272-283 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A06

The purpose of this report is the establishment of a method of producing good images for visual interpretation, after examination of the character of MOS-1 (Marine Observation Satellite-1) data and problems in expressing all of the information in these data on photographic films and paper. Because there is no special problem in imaging VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data, investigation is mainly made on two-scene data of MESSR (Multispectral Electronic Self-Scanning Radiometer). Because of difference of data character, sea and land area are examined separately. For comparison, TM (Thematic Mapper) images created by averaging data of each of four pixels and MSS (Multi Spectral Scanner) images are used. There are no special problems with sea area imaging. On land area, visual interpretation of MESSR images with two kinds of transfer functions and TM images are made on various objects, and the character of each data set is precisely examined. Also, effects of band combination and color sequence are examined, and the best combination and sequence are selected. It is found that ranges of MESSR data are very narrow; data levels are located low, and these images are not so suitable to visual interpretation on land area. However, it is confirmed that these images are useful at sea area. Author (NASDA)

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EVALUATION OF MOS DATA FOR FOREST RESOURCE INVENTORY

HARUO SAWADA (Forestry and Forest Products Research Inst.,

Ibaraki (Japan).), YOSHIO AWAYA (Forestry and Forest Products Research Inst., Ibaraki (Japan).), ITSUHIITO OHNUKI (Hokkaido Univ. of Education, Iwamizawa (Japan).), KAZUHIKO KOGI (Shikoku Chemical Research Industries, Inc., Ibaragi (Japan).), and FUMITOSHI TAKAHASHI (Forestry and Forest Products Research Inst., Kouchi, Japan) *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 284-295 Mar. 1990 In JAPANESE; ENGLISH summary*
 Avail: CASI HC A03/MF A06

An outline of the results of an evaluation of MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) data for a forest survey is presented. For the evaluation of MESSR data, ground survey records (tree species, mean diameter of breast height, stand height, number of trees per hectare, stand volume, etc) are gathered and used for the correlation analysis between spectral characteristics and forest conditions. Canonical correlation analysis was very effective for obtaining the MESSR data characteristics in the forest inventory. Vegetation indices derived from MESSR data were evaluated for forest type classification. And ratio indices using visible channel(s) and infrared channel(s) were found to be effective for delineating well vegetated areas. For the evaluation of VTIR data, a composite image was made using two sequence passes; a relatively cloud-free image was obtained. But lack of an infrared channel does not make it so effective for observing forest conditions. Author (NASDA)

**N92-22999# Japan Forest Technical Association, Tokyo.
 STUDY FOR FOREST BIOMASS REMOTE SENSING BY
 MESSR DATA**

IWAO NAKAJIMA, HIROSHI WATANABE, and YUKIO WADA *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 296-300 Mar. 1990*
 Avail: CASI HC A01/MF A06

Vegetation and land use classification for a forest biomass study using MESSR (Multispectral Electronic Self-Scanning Radiometer) data from a forest site in Gunma and Gifu prefectures was done. LANDSAT MSS (Multi Spectral Scanner) and TM (Thematic Mapper) data classification were used for comparison. Spectral data recognition items amounted to nine and 22 categories in Gunma and ten items in Gifu using the maximum likelihood method and MESSR data processing. MESSR data recognition results showed 85.4 percent average correctness on training area coincidence, comparing 79.5 percent of MSS data, 88.8 percent by MESSR data and, 0.3 percent by TM data in Gifu. An adequate graphic display method was also tested for forest biomass classification mapping in Gunma by using the vegetation index calculation, showing results similar to those obtained with MSS data. Author (NASDA)

**N92-23000# Tokyo Univ. (Japan). Inst. of Industrial Science.
 GEOMETRIC CORRECTION OF VTIR IMAGERY AND ITS
 APPLICATIONS**

SHUNJI MURAI (Tokyo Univ. (Japan).), TOSHIKI HASHIMOTO (Tokyo Univ. (Japan).), HIROAKI KAKIUCHI (Tokyo Univ. (Japan).), and OSAMU UCHIDA (Asia Air Survey Co. Ltd., Atsugi, Japan) *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 301-309 Mar. 1990 In JAPANESE; ENGLISH summary*
 Avail: CASI HC A02/MF A06

Studies on geometric correction of MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) imagery and its application to analysis of geosurface temperature were carried out. Two types of methods were adopted. Both made use of Ground Control Points (GCPs), which were acquired from shore lines, large rivers, etc. on topographical maps. The image coordinates corresponding to the GCPs were obtained from Band 3 because they were clearer than any other band. The first method solved a transformation function, a three dimensional polynomial, between image coordinates and geographical coordinates using GCPs. The other method treated the positions and attitudes of the satellite as the unknown variables and determined them by the collinearity equation which is utilized in photogrammetry. The

calculations was carried out using the earth center rotation coordinates system where the earth surface was approximated by Bessel's ellipsoidal model, and the results were transformed into geographical coordinates. The positions and attitudes of the satellites were supposed to be functions of line number and expressed by two dimensional polynomials. The Root Mean Square (RMS) was approximately four pixels using the former method and less than one pixel using the latter. Since both utilized GCPs acquired only from land areas, the accuracy was not guaranteed in off-shore areas. But these methods, especially the latter one, were useful to geometric correction of VTIR imagery where GCPs could be acquired. In this study, the surface temperature of the objects was expressed as a bird's eye view using Band 3 and digital elevation models; correlation between altitude and surface temperature was analyzed. Author (NASDA)

N92-23001# Kyoto Univ., Uji (Japan). Disaster Prevention Research Inst.

**A STUDY OF CLOUD AND SNOW COVER OVER KINKI
 DISTRICT, WEST JAPAN**

JIRO INOUE *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 310-314 Mar. 1990*

Avail: CASI HC A01/MF A06

Several pairs of cloud streets are found in the central part of Kinki district, west Japan in MOS-1 (Marine Observation Satellite-1), VTIR (Visible and Thermal Infrared Radiometer) images of January 10, 1988. Meteorological observatories reported the occurrence of snowfalls despite the fact that the major area of central Kinki was clear or partly cloudy. These cloud streets are possibly produced inland and cause the local isolated snow showers. A ground traced snow survey was made in the northern part of Kinki to estimate the amount of total snow cover, but the cloud free image of MOS-1 was not available due to the short time of snow cover duration. Author (NASDA)

**N92-23002# Nagaoka Technological Univ., Niigata (Japan).
 OBSERVATION OF LINED-UP CUMULUS ROWS OVER THE
 JAPAN SEA UNDER THE WINTER MONSOON SITUATION
 USING MOS-1 DATA**

TOSIO KOIKE (Nagasaki Univ. (Japan).), KATUMI MUSIAKE (Tokyo Univ. (Japan).), and TAKASI MIZUNO (Niigata Prefectural Government, Sinkou, Japan) *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 315-321 Mar. 1990 In JAPANESE; ENGLISH summary*
 Avail: CASI HC A02/MF A06

At a frequency below 50 GHz, water vapor has a rotational absorption line at 22.235 GHz and the absorption coefficient of cloud liquid water increases with high frequency. MSR (Microwave Scanning Radiometer) observes the earth at 23.8 GHz and 31.4 GHz. These frequencies are optimal for separately retrieving water vapor and cloud liquid water contents in the atmosphere. Data processing of two scenes of the MSR and VTIR (Visible and Thermal Infrared Radiometer) aboard MOS-1 (Marine Observation Satellite-1) has been made. One scene is for verification on February 10, 1988, and another scene on January 10, 1988 is used for the estimation of water vapor and cloud liquid water distributions over the Japan Sea in wintertime. In conclusion, the water vapor and cloud liquid water contents retrieved by MOS-1 MSR and VTIR are verified qualitatively, and characteristics of cumulus group activity over the Japan Sea in wintertime in relation to water vapor convergence is identified. Author (NASDA)

N92-23003# Hokkaido Inst. of Tech. (Japan).

**EVALUATION OF THE DATA MEASURED BY MSR RELATED
 TO SNOWPACK PARAMETER**

MASAHIRO SUZUKI (Hokkaido Univ. of Education, Iwamizawa (Japan).), MASAMI SASAKI (Hokkaido Univ. of Education, Iwamizawa (Japan).), KAZUO FUJINO (Hokkaido Univ. of Education, Iwamizawa (Japan).), and TAKEO ABE (Niigata Univ., Japan) *In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 322-327 Mar. 1990*

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In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

Analyses have been conducted to related snowpack parameters to the microwave radiometric observations made by aircraft and orbiting sensors (MOS-1 (Marine Observation Satellite-1)). A comparison between ground truth data and data obtained by MSR (Microwave Scanning Radiometer) for snowpack was made, and the following is concluded: (1) the brightness temperature obtained by MSR exhibits a remarkable sensitivity to snow depth and water equivalent of snowpack; (2) snow depth/water equivalent and the brightness temperature obtained by MSR are correlated with regression line of a negative slope; however, when the snowpack is covered with new snow layer, the slope of regression line is inverted; and (3) the seasonal variations in the brightness temperature obtained by MSR on MOS-1 are correlated with those of snowpack in the area. Author (NASDA)

N92-23004# Environmental Research and Technology Inst., Tokyo (Japan).

STUDY ON SNOW HYDROLOGY THROUGH APPLICATION OF MOS-1 SATELLITE DATA

KENJI ISHIHARA (Environmental Research and Technology Inst., Tokyo (Japan).), TATSUO IZAWA (Environmental Research and Technology Inst., Tokyo (Japan).), MASAOMI AKAGAWA (Environmental Research and Technology Inst., Tokyo (Japan).), KIYOSHI TSUCHIYA (Chiba Univ. (Japan).), TAKASHI ISHIYAMA (Chiba Univ. (Japan).), MASAO MATUMOTO (Chiba Univ. (Japan).), KAZUO WATANABE (Remote Sensing Technology Center, Tokyo (Japan).), and KATSUTOSHI KOZAI (Kobe Univ. of Mercantile Marine, Japan) /n NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 328-350 Mar. 1990

Avail: CASI HC A03/MF A06

Using various classification methods, MESSR (Multispectral Electronic Self-Scanning Radiometer) image data of Ishikari prefecture, Hokkaido as observed during the melting snow season are classified into snow covered and snow-free areas, and the influence of vegetation in the accuracy of snow line detection is investigated. Based upon MSR (Microwave Scanning Radiometer) data covering Hokkaido and its surrounding ice-free sea, relationship between MSR brightness temperature and snow depth in the inland area, and the effect of the sea on the brightness temperature in the inland area of Hokkaido are discussed.

Author (NASDA)

N92-23005# Maritime Safety Agency, Tokyo (Japan).

SYNOPTIC OBSERVATION OF SEA ICE

TOSHIO HATTORI, HARUHIKO URA, and SATOSHI SATO /n NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 351-358 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A06

In order to keep navigation safe and to prevent marine accidents, prompt reports of sea ice, which contain maps of ice made from the observation data by ships, airplanes, satellites, etc. are published. In this experiment, whether MOS-1 (Marine Observation Satellite-1) data can be available to distinguish sea ice from open water, and discrimination of sea ice forms were examined. The concentration and forms of ice are related to surface temperature, so that with VTIR (Visible and Thermal Infrared Radiometer) infrared images, sea ice from open water can be distinguished to some extent. With VTIR visible images, it is easier to discriminate sea ice, but clouds from sea ice with visible image cannot be distinguished. In the case of MESSR (Multispectral Electronic Self-Scanning Radiometer), spatial resolution is so high that it is very easy to distinguish sea ice from open water and to discriminate forms of sea ice. Author (NASDA)

N92-23006# Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

SEA-ICE FEATURES INTERPRETED IN A COMBINATION OF MULTI SENSOR DATA

NOBUO ONO /n NASDA, Proceedings of the Third Symposium

on MOS-1 Verification Program (MVP), No. 1 p 359-365 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

Sea ice features in the Okhotsk Sea are studied using MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) data in combination with VTIR (Visible and Thermal Infrared Radiometer) and MESSR (Multispectral Electronic Self-Scanning Radiometer) data. Results of the case study of such data set on 31 Mar. 1988 are summarized as follows: brightness temperatures (without atmospheric correction) both MSR 31 GHz (CH 4) and 23 GHz (CH 2) of Okhotsk sea-ice range widely from 150 to 225 K, and give a reasonable distribution of sea-ice features. Polynyas (open water or thin-ice areas in sea-ice region) are clearly recognized in Terpenia Bay and in Aniva Bay. The ratio of brightness temperatures (CH 4/CH 2) indicates the difference of Marginal Ice Zone (MIZ) between off the coast of Hokkaido and in the central part of the Okhotsk Sea. Author (NASDA)

N92-23007# National Space Development Agency, Tokyo (Japan). Branch of Oceanographic Studies.

ESTIMATION OF WAVES AND WINDS OVER SEAS IN THE COASTAL ZONE

ATSUSHI TAKEDA, MASAYUKI TOKUDA, SHINICHI IWASAKI, ISAO WATABE, TOSHIKAZU MOROHOSHI, and SHINOBU YAZAKI /n NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 366-371 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan
Avail: CASI HC A02/MF A06

A method with which quantitative informations of ocean waves and sea surface winds are obtained from an imagery of visible bands of MESSR (Multispectral Electronic Self-Scanning Radiometer) is discussed. Discrimination of the individual waves patterns from MESSR imagery is practically difficult because of lower resolution of 50 m, while it is narrowly possible from an imagery of TM (Thematic Mapper) or SPOT. There is, however, another approach to obtain the informations from a MESSR imagery. A population density of white caps generated by wave breaking increases with increasing wind speeds. A high density of the white caps over the sea surface will be reflected on the MESSR imagery as a bright spot which can be detected. In fact, a correlation is found between densities of high brightness and wind speeds over a sea area. It can be concluded that wind speeds are estimated from MESSR imageries with considerations on the fetch and duration. Author (NASDA)

N92-23008# Central Research Inst. of Electric Power Industry, Chiba (Japan).

ADVANCEMENT OF SEA SURVEY AND OBSERVATION TECHNIQUE IN THE SEA AROUND POWER PLANTS

NAOAKI KATANO (Central Research Inst. of Electric Power Industry, Chiba (Japan).), MASAFUMI MIZUTORI (Central Research Inst. of Electric Power Industry, Chiba (Japan).), HIROMARU HIRAGUCHI (Central Research Inst. of Electric Power Industry, Chiba (Japan).), KINYA ADACHI (Mitsubishi Research Inst., Inc., Tokyo (Japan).), MICHIO OISHI (Mitsubishi Research Inst., Inc., Tokyo (Japan).), SHINTARO GOTO (Mitsubishi Research Inst., Inc., Tokyo (Japan).), and SANA E INAMURA (Mitsubishi Research Inst., Inc., Tokyo, Japan) /n NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 372-384 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A06

Studies were carried out on the applicability of a MESSR (Multispectral Electronic Self-Scanning Radiometer), a VTIR (Visible and Thermal Infrared Radiometer), and a MSR (Microwave Scanning Radiometer) mounted on the MOS-1 (Marine Observation Satellite-1) satellite to oceanographic observations and their estimated accuracy, based on the results of observations conducted simultaneously at sea. Regarding the water quality, a relatively high correlation was obtained with respect to chlorophyll-a, SS (Suspended Solid), and transparency through the multiple regression analysis of MESSR Bands 1 and 2, but it was difficult to extract characteristics by each water quality item. As

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for observation of sea-surface temperatures by VTIR, the highest correlation was obtained in the regression analysis using three infrared bands including Band 2 which was considerably affected by water vapor. As for waves, no clear correlation with MSR data was recognized. On the other hand, in the image given by X-Band radar, which has a wavelength band different from MSR, a correlation with the sea wind was recognized, thus, suggesting that from the relation between the sea wind and waves it is possible to indirectly apply these data to wave observations.

Author (NASDA)

N92-23009# Maritime Safety Agency, Tokyo (Japan). Hydrographic Dept.

MONITORING OF OCEAN CONDITIONS BY USING MOS-1 DATA

HARUO ISHII, HIDEO NISHIDA, MINORU KIMURA, YUTAKA MICHIDA, SHOUICHI TSUCHIDE, KAZUO TSUKAHARA, and SATOSHI SATO /In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 385-390 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

There are two purposes in this study: (1) estimation of the availability of MOS-1 (Marine Observation Satellite-1) data for mapping of oceanographic conditions (ocean current, temperature, and so on); and (2) examination of capability of MOS-1 data for monitoring discolored water discharged from submarine volcanoes. Systematic cloud filtering in VTIR (Visible and Thermal Infrared Radiometer) infrared image data (Band 3) was examined with visible image data (Band 1). Because variance of brightness in sea region was small compared with that of the in cloud region of both bands, the brightness values to distinguish cloud region from sea region could be decided with a two-dimensional histogram. MESSR (Multispectral Electronic Self-Scanning Radiometer) CCT (Computer Compatible Tape) data, dated July 17, 1987 was analyzed for the purpose of distinguishing discolored water discharged from the submarine volcano, Fukutoku Oka-no-Ba, which was observed from an airplane on that day. Consequently, it was shown that a certain combination of brightness (in Band 1, 2, and 3) gave discolored water.

Author (NASDA)

N92-23010# Ministry of Transportation, Kanagawa (Japan). Port and Harbour Research Inst.

APPLICATION OF THE REMOTE SENSING TECHNIQUES BY SATELLITE TO THE MONITORING SYSTEM FOR MARINE CONSTRUCTION

KAZUO MURAKAMI, HUMINORI SUGANUMA, and YUJI MIYAHARA /In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 391-400 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

The field investigation is carried out at the mouth of Tokyo Bay for the purpose of the development of the monitoring system for marine construction by remote sensing technique. The remote sensing observations by a MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) and an aircraft MSS (Multispectral Scanner), together with the sea truth observation, were carried out simultaneously on Feb. 1988. These remote sensing data and the sea truth data are analyzed by statistical analysis. By using these data, horizontal distributions of water temperature and turbidity are obtained.

Author (NASDA)

N92-23011# National Aerospace Lab., Tokyo (Japan).
A STUDY ON INFORMATION ANALYSIS AIDS SYSTEM FOR SEA SURFACE TEMPERATURE MAPS

HAJIME KOSHIIISHI (National Aerospace Lab., Tokyo (Japan).), MASAO NAKA (National Aerospace Lab., Tokyo (Japan).), HIROMICHI YAMAMOTO (National Aerospace Lab., Tokyo (Japan).), KOHTARO MATSUMOTO (National Aerospace Lab., Tokyo (Japan).), KOHZO HOMMA (National Aerospace Lab., Tokyo (Japan).), SATSUKI MATSUMURA (Far Seas Fisheries Research Lab., Shimizu (Japan).), HIDEO TAKAHASHI (Japan Fisheries Information Service Center, Tokyo.), SATORU NAKAMURA (Japan

Fisheries Information Service Center, Tokyo.), HIDEO TAMEISHI (Japan Fisheries Information Service Center, Tokyo.), YOSHIHIRO OKADA (Japan Fisheries Information Service Center, Tokyo.) et al. /In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 401-407 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

In this study, a feasibility study on information analysis aids system for sea surface temperature image data using knowledge based processing technology has been performed. Oceanic conditions such as fronts, ocean currents, and eddies are very useful for fisheries. For extracting these oceanic conditions, the accumulated knowledge and inherited experience are indispensable, and the simplicity of the processing and the objectivity of the result are important. The knowledge based processing system has great possibilities of dealing with these problems. In this paper, the existing expert knowledge and experience used in the process of recognizing oceanic conditions are analyzed for the systematization. Furthermore, the basic structure and the implementation of a prototype knowledge based system are described. The system has been proven to work successfully in a set of experiments using MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data.

Author (NASDA)

N92-23012# Tohoku Univ., Sendai (Japan). Dept. of Geophysics.

A COMPARISON OF SEA SURFACE TEMPERATURE DETECTED BY MOS-1/VTIR AND FERRIES, ISHIKARI AND OGASAWARA, AND DISCUSSION OF THE RESULTS FROM ASPECTS OF PHYSICAL OCEANOGRAPHY

HIROSHI KAWAMURA, KIMIO HANAWA, and YOSHIAKI TOBA /In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 408-420 Mar. 1990
Avail: CASI HC A03/MF A06

Sea Surface Temperatures (SST) observed by MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) Band 3 (10.5-11.5 micrometers in wavelength) is compared with in-situ data set of SST obtained by the ferry Ishikari. This ferry shuttles between Nagoya and Tomakomai via Sendai along the Pacific coast of Japan in four days. The Level-2 data of five scenes of VTIR obtained from June 1987 to April 1988 are analyzed, and the SST of VTIR are carefully sampled at the check-points on the ship's course for comparison with in-situ SST obtained by the Ishikari. The comparison shows that the mean difference is -1.27 C (the VTIR data are lower) with the standard deviation of 0.77 C. It is also shown that the thermal images of VTIR can be used to observe the oceanic structure with synoptic scale.

Author (NASDA)

N92-23013# Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.

BUOYANCY-DRIVEN CURRENT IN THE BUNGO CHANNEL

HIDEKI AKIYAMA, HIDETAKA TAKEOKA, and TETSUO YANAGI /In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 421-433 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A06

The field observations at the Bungo Channel were carried out from 22 Jun. to 13 Sept. 1988 in order to investigate the behavior of buoyancy-driven current. Temporal variations in temperature, salinity, and current followed by the buoyancy-driven current were observed at Uwajima Bay. The horizontal and vertical structures of the intrusion of buoyancy-driven current were also observed at the mouth of the Bungo Channel. The Level-2 data of the Band 3 (10.5-11.5 micrometers in wavelength) of MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) are analyzed. Sea surface temperature obtained by this image is compared with in-situ temperature data. Temperature values of this image agree well with those of in-situ data within 1 C.

Author (NASDA)

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N92-23014# Toba Merchant Marine Coll. (Japan). Marine Meteorology Lab.

APPLICABILITY OF MESSR AND VTIR DATA FOR MARINE OBSERVATION Report No. 2

HIROAKI OCHIAI / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 434-439 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

Using the data obtained by MOS-1 (Marine Observation Satellite-1), an evaluation of remote sensing in monitoring the marine environment was performed. The results were the following: (1) the water characteristics in Ise Bay can be estimated by color sliced imagery produced from Band 1 and Band 4 of MESSR (Multispectral Electronic Self-Scanning Radiometer); (2) the sea surface temperature distribution pattern around Kuroshio Current is recognizable in color sliced imagery of VTIR (Visible and Thermal Infrared Radiometer); (3) in comparison with MSS (Multi Spectral Scanner) or TM (Thematic Mapper) data obtained by LANDSAT-5, MESSR data is sufficient to estimate the water characteristics in coastal area; and (4) in the comparison with AVHRR (Advanced Very High Resolution Radiometer) data obtained by NOAA, VTIR is concluded as very effective in estimating the sea surface temperature distribution both in coastal area and off shore.

Author (NASDA)

N92-23015# Science Univ. of Tokyo, Chiba (Japan). Dept. of Civil Engineering.

MOS-1 DATA BEING ENROLLED IN TO THE KUROSHIO EDDY OBSERVATION SYSTEM

TSUKASA NISHIMURA (Tokyo Univ. (Japan).), SOTARO TANAKA (Roph Corp., Chula Vista, CA.), TOSHIRO SUGIMURA (Yanagita (Tomotake), Takakura (Japan).), and YUJI HATAKEYAMA (Asia Air Survey Co. Ltd., Atsugi, Japan) / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 440-447 Mar. 1990

Avail: CASI HC A02/MF A06

In this verification experiment, MOS-1 (Marine Observation Satellite-1) data were evaluated in order to use it in our Kuroshio Eddy Observation System, a real-time system designed to monitor the coherent structure of turbulence in the sea environment of Japan. The time scale of this rapidly moving target is days or tens of days, and the space scale is kilometers or hundreds of kilometers. When the system architecture of MOS-1 was specified, this coherent structure was not yet detected. The MOS-1/VTIR (Visible and Thermal Infrared Radiometer) data was verified to have a radiometric and spatial resolution satisfactory for interpretation of the coherent structure on it. The most critical issue is its lower frequency of acquisition, when an attempt to apply the data as the main force is made. Based on this verification experiment, it is recommended that one of the operation-phase Marine Observation Satellite systems will be designed to be focused on the marine coherent structure around Japan, which is a highly energetic element of the global air sea system. Author (NASDA)

N92-23016# Science Univ. of Tokyo, Chiba (Japan). Dept. of Civil Engineering.

ADAPTABILITY OF MOS-1 DATA TO VISUALIZATION OF COASTAL HYDRAULIC PHENOMENA

SOTOAKI ONISHI (Tokyo Univ. (Japan).) and ITSUO SAKAI (All Japan Fishing Port Construction Association, Chiba.) / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 448-459 Mar. 1990

Avail: CASI HC A03/MF A06

With the object of making clear the behaviors of river effluents at such water region that the coastal and oceanic current systems interact each other, the distributions of the effluents discharged from the Kumano River into the Pacific Ocean are visualized, by using the satellite remote sensing such as MOS-1 (Marine Observation Satellite-1) as well as LANDSAT. Then, those behaviors are simulated numerically for six cases, in each of which different combinations of values of the concerning physical parameters such as rate of flow, effluent thickness, roughness at sea bed, spatial and time scales of relating phenomena are

assumed and examined their importance for making up those distributions obtained with the satellite remote sensing. The numerical simulations indicate that the area, at which the effluent behaviors are controlled by the inertia, is within 10 to 15 km off the river mouth, regardless of the time and spatial scales of the concerned phenomena, the bed roughness and the effluent thickness. The directions of the effluents shall deviate to the right hand side after reaching the Coriolis force dominating field offshore, and its deviation increases with reducing the roughness at the sea bed, the discharge rate and the thickness of the effluent.

Author (NASDA)

N92-23017# Hiroshima Inst. of Tech. (Japan). Dept. of Civil Engineering.

COASTAL ENVIRONMENTAL MONITORING USING MOS-1 MESSR DATA

YUZO SUGA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 460-464 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A01/MF A06

This study deals with the problems in order to obtain the coastal environmental information from MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data acquired by a high gain mode. Sea truth experiment performed the water quality parameter analysis to monitor the water pollution in Hiroshima Bay, simultaneously with MOS-1 observation. Coastal environmental information could be obtained by the principal component analysis. As a result, a first principal component has a accumulated contribution of 7.7 percent, then the imagery color-coded by the level slicing was generated. A characteristic of water quality in this study area which is the typical closing bay was interpreted by the analyzed imagery. It is considered that the radiometric and spatial resolution of MOS-1 MESSR data acquired by a high gain mode is available for the assessment of water quality in this bay scale. Author (NASDA)

N92-23018# Ministry of Construction (Japan). Coastal Engineering Div.

ESTIMATION OF RADIOMETRIC EFFICIENCY OF VTIR, MESSR BASED ON SEA TRUTH DATA

TAKAAKI UDA, YOSHIMI MURAI, and TSUTOMU TAKEBUCHI / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 465-470 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A06

Diffusion of turbid water around the mouth of the Oi River was observed simultaneously using ships and MOS-1 (Marine Observation Satellite-1). It is found that Band 1 of MESSR (Multispectral Electronic Self-Scanning Radiometer) data and turbidity did not correlate with each other directly. Some data were affected by the existence of cloud, and therefore brightness of MESSR data was overestimated. When corresponding data of Band 1 were removed, correlation between MESSR data and turbidity was improved.

Author (NASDA)

N92-23019# Toyama National Coll. of Maritime Technology, Shinminato (Japan).

CASE STUDIES OF EARTH SURFACE OBSERVATION USING MOS-1. 1: COLOR OF SEA AND TRANSPARENCY. 2: SST. 3: ACTUAL VEGETATION

SHIGEKI ISHIMORI (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), MASASHI KAWAI (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), TAKASHI MACHIMURA (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), NORIHISA KAMIBAYASHI (Toyama National Coll. of Maritime Technology, Shinminato (Japan).), and HIROSHI WAKABAYASHI (Toyama Prefectural Fishery Experimental Station, Namerikawa, Japan) / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 471-483 Mar. 1990

Avail: CASI HC A03/MF A06

The availability of MOS-1 (Marine Observation Satellite-1) data on earth surface observation was studied for three cases, as

follows: (1) To what extent does the MESSR (Multispectral Electronic Self-Scanning Radiometer) data explain the color of sea and transparency; In order to examine these relations, MESSR data were combined with in situ data by employing simple statistical methods; (2) Experimental and theoretical algorithms were developed to derive SST (Sea Surface Temperature) using two thermal infrared bands of VTIR (Visible and Thermal Infrared Radiometer). The accuracy was investigated by comparing with SST measured by ships and buoys; and (3) The feasibility of actual vegetation identification was examined with MESSR data. In this study, black and white aerial photos were utilized as ground reference. Author (NASDA)

N92-23020# Okayama Univ. (Japan). Faculty of Engineering. **ENVIRONMENTAL SURVEY IN COASTAL REGIONS** CHUJI MORI (Okayama Univ. (Japan).), KOICHI OZAKI (Okayama Univ. (Japan).), OSAMI KAWARA (Okayama Univ. (Japan).), and YUZO SUGA (Hiroshima Inst. of Tech., Japan) In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 484-493 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A06

Records of MESSR (Multispectral Electronic Self-Scanning Radiometer) with correction Level-2 were used. The locations are Okayama and Himeji (Path 24 - Row 71 and 23-71), coastal area of the Seto Inland Sea. The characteristics of the area are as follows: Individual units of land use are fragmented and complicated. Currents in the sea change in both velocity and direction at place by place, with time by time. There are so many small islands, that enough number of ground control points can be found. Geometrical accuracy of MESSR records is fairly good. Transformations between the image coordinates of MESSR and UTM (Universal Transverse Mercator) coordinates, and also between the two image coordinates, show that the error is smaller than one pixel pitch. At sea surface, noise of CCT (Computer Compatible Tape) count is within the limit plus or minus one count, and the characteristics of it differ from scene to scene. An easy and effective method for eliminating the noise is to do median filtering. It was recognized that differences of radiance on a sea surface could be found from the data recorded by low gain. CCT count changed according to the two kinds of sea truth data, suspension solids and chlorophyll-a. Several types of relations between them were found from a regression analysis. Reliability of the relations is not so good at present. Author (NASDA)

N92-23021# Japan Fisheries Information Service Center, Tokyo.

APPLICATION OF MOS-1 MESSR DATA FOR FISHING GROUND OF COASTAL AREA

HIDEO TAMEISHI, OSAMU HONDA, YOSHIHIRO OKADA, and TOSHIYUKI KOUGUCHI In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 494-501 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A06

This study presents outlines of basic estimation as follows: (1) It is investigated whether the relationship between optical data of MESSR (Multispectral Electronic Self-Scanning Radiometer) and fishing-ground; (2) The computed irradiance in MOS-1 (Marine Observation Satellite-1) Band 1 and 2 was normalized by the ratio of Band 1/Band 2 and the relationship between the ratio and the distribution of chlorophyll-a, and the formation of sardine fishing ground are investigated; and (3) Whether the oceanographical phenomenon such as small-scale eddies at the coastal zone is able to be expressed. To verify the effectiveness of MOS-1 MESSR are compared with simultaneous fishing ground data. The results were obtained as follows: (1) It seems that the MOS-1 VTIR (Visible and Thermal Infrared Radiometer) data are applicable to forecasting of skipjack fishing ground. Because, the mean correct discrimination rate reached 82 percent for MOS-1 VTIR data and proved its usefulness; (2) Mackerel fishing ground in coastal area are formed on the boundary between the coastal turbid waters and the offshore clear ones; (3) Sardine and anchovy fishing grounds in coastal area are formed on the frontal zone of water color in coastal

turbid waters area; (4) MOS-1 MESSR imagery which represents the results of Band 1/Band 2 fit in well with the sea truth data of chlorophyll-a distribution. The fishing grounds of sardine are formed at the edge of its maximum irradiance; and (5) It seems that a small scale eddy (20 km across), exit on MOS-1 MESSR imagery.

Author (NASDA)

N92-23022# Asia Air Survey Co. Ltd., Atsugi (Japan). **VERIFICATION OF RADIOMETRIC CHARACTERISTICS OF MESSR AND VTIR DATA BY COMPARISON WITH LANDSAT AND NOAA DATA**

MICHIO YOKOTA, KENTARO NARIGASAWA, KAZUYA SAITOH, NOBUYUKI MIZUTANI, and KAZUMI YAMAZAKI In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 502-514 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A06

MESSR (Multispectral Electronic Self-Scanning Radiometer) data of clear and turbid water areas in Tokyo Bay were compared with existing LANDSAT MSS (Multi Spectral Scanner) and TM (Thematic Mapper) data of the same areas. The difference in average MESSR CCT (Computer Compatible Tape) counts in clear water areas and turbid water areas was smaller than the difference observed in TM data and almost the same with the difference observed in MSS data. VTIR (Visible and Thermal Infrared Radiometer) data were compared with NOAA AVHRR (Advanced Very High Resolution Radiometer) data. The ratio of effective radiometric resolution of VTIR to that of AVHRR was approximately 0.22. Large scale temperature distribution pattern of sea surface was detected by VTIR images as well as AVHRR images. VTIR data of two successive days also proved that the data can show a change in temperature distribution pattern. Author (NASDA)

N92-23023# Seikai Regional Fisheries Research Lab., Kokubu (Japan).

MAPPING OF ENVIRONMENTAL FACTORS OF THE SEAWATER ON THE ESTUARIES IN WESTERN KYUSHU USING MOS-1 DATA

SHIROH UNO (Seikai Regional Fisheries Research Lab., Kokubu (Japan).), KAZUYA SAITOH (Asia Air Survey Co. Ltd., Atsugi (Japan).), and SAM WOUTHUYZEN (Nagasaki Univ., Bunkyo, Japan) In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 515-521 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A06

The map of some environmental factors at the estuaries in western Kyushu was attempted to make using satellite 'MOS-1 (Marine Observation Satellite-1)' data. The sea truth data on chlorophyll and Seston indicated low correlation coefficients with the image density of MOS-1. Only the coefficients of transparency in the Ariake Bay exceeds 0.6 at the formula of Band 2/Band 1. Then distribution map of the transparency was made by this calculation. The tendency of the distribution was reliable, however some unreasonable higher values were found at some areas in the open sea or in the central part of the bay. These low values of the correlation coefficients would be depended on the peculiarity of the bay; higher concentration of phytoplankton and inorganic soil materials from rivers. Author (NASDA)

N92-23024# Lake Biwa Research Inst., Shiga (Japan).

MONITORING OF LAKE ENVIRONMENTS BY MOS-1

MICHIO KUMAGAI, HIROTO MAEDA, and YUKIO ONISHI In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 522-529 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan

Avail: CASI HC A02/MF A06

A verification experiment to monitor lake environments by MOS-1 (Marine Observation Satellite-1) was performed. Comparing MESSR (Multispectral Electronic Self-Scanning Radiometer) data with lake-truth data, the surface distribution of SS (Suspended Solid), chlorophyll-a and transparency can be estimated. The estimated values from MESSR data, which were taken on fine

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days, yielded good agreement with field data. In Lake Biwa, however, a better estimation of water quality distribution requires the data in both northern and southern basin, because there is a wide water quality difference between the two basins.

Author (NASDA)

N92-23025# Tohoku Regional Fisheries Research Lab., Miyagi (Japan).

MONITORING OF UNDERWATER FOREST PRODUCTION BY USING MOS-1

MITSUYUKI HIRAI (Tohoku Regional Fisheries Research Lab., Miyagi (Japan).), KAZUYA TANIGUCHI (Tohoku Regional Fisheries Research Lab., Miyagi (Japan).), and NORIHITO TSUZUKI (Nakanihon Air Service Co. Ltd., Aichi, Japan) In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 530-537 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan

Avail: CASI HC A02/MF A06

It is important to estimate the production of seaweeds for appropriate management of fishing grounds for herbivores, such as abalones and sea urchins. Diving survey and image processing of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) and air-borne MSS (Multi Spectral Scanner) were carried in the Arame (*Eisenia Bisyli*) population on the coast of Oshika Peninsula, to examine the feasibility of MOS-1 MESSR as a estimation method for its production. The characteristic distribution pattern of Arame investigated by diving was retrieved by MSS image, however, such pattern could not be recognized on MOS-1 MESSR images. Consequently, it is concluded that MOS-1 MESSR data is less feasible to estimate the production of seaweeds in the coastal waters.

Author (NASDA)

N92-23026# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanographic Div.

UTILIZATION OF SATELLITE IMAGES FOR MARINE RESOURCES

DENZO INAGAKE and AKIRA TOMOSADA In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 538-548 Mar. 1990 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan

Avail: CASI HC A03/MF A06

A lot of small-scale phenomena at the sea surface are detected by satellite images. Since these phenomena are estimated to have important roles not only for the oceanographic structures but also for the concentration, distribution or movement of fish schools, it has been tried to make clear those structures and their roles for fisheries resources. The sea truth data were acquired synchronized to the MOS-1 (Marine Observation Satellite-1) Verification Program on August 5-8, and December 3-5, 1987. And small scale phenomena such as a warm tongue and a cold streamer around the Kuroshio warm-core ring were observed on board the R/V (Research Vessel) Soyo Maru. These observation results suggest that small scale phenomena around the Kuroshio warm-core ring recognized in some satellite images not only really exist but also have structures to the considerable depth. It is considered that these phenomena are important for the distribution of fish schools and their migrations. We are trying to make clear the mechanism of the concentration of mackerel schools at spawning grounds around Izu Islands in winter 1987 and of sardine schools at nursery grounds southeast of Hokkaido Island in summer 1987, using some infrared images. The possibility is being examined that the sardine schools can be detected directly by visible images.

Author (NASDA)

N92-23027# Remote Sensing Technology Center, Tokyo (Japan).

CAPABILITY OF DETECTION OF KUROSHIO AXIS FROM MSR DATA

SOTARO TANAKA (Tokyo Univ. (Japan).), TOSHIRO SUGIMURA (Tokyo Univ. (Japan).), KAZUO WATANABE (Tokyo Univ. (Japan).),

TSUKASA NISHIMURA (Tokyo Univ. (Japan).), and YUJI HATAKEYAMA (Asia Air Survey Co. Ltd., Atsugi, Japan) In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 549-556 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A06

Using MOS-1/MSR (Marine Observation Satellite-1 Microwave Scanning Radiometer) data, a capability of Kuroshio axis detection was tested. The result is that MOS-1/MSR bands, i.e., 23 GHz and 31 GHz, are not effective in detecting the sea surface temperature, because the radiation increment from the sea surface in these bands which depends upon its temperature is less than that which depends upon the other physical parameters. However, a less meaningful result that the water vapor increases in proportion to the sea surface temperature, and the brightness temperature increases in proportion to the water vapor evaporated from the sea surface, was obtained. Consequently, the MSR responses virtually to the sea surface temperature in clear sky condition. But, the pure MSR response to the sea surface temperature is relatively very weak against the noise caused by the water vapor in the transmitting path. Increment of MSR measure by Kuroshio axis thermal increment corresponds to about 1 mm water vapor. This noise makes the measurement of Kuroshio axis difficult in actual weather condition. New band test between 1 GHz to 8 GHz in which the band radiation depends more upon the sea surface temperature is requested. Improvement of the spatial resolution and pure data detection with less side lobe are also necessary.

Author (NASDA)

N92-23028# Nagasaki Univ. (Japan). Dept. of Civil Engineering.

DETECTION OF WATER RESOURCES AND THEIR RESERVATION ON THE SEA BASED ON SATELLITE REMOTE SENSING

KEINOSUKE GOTOH (Nagasaki Univ. (Japan).) and MASATOSHI MORI (Kinki Univ., Osaka, Japan) In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 p 557-571 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A06

A concept was proposed to reserve the ground water which flows out to the seashore and snow water discharges into the sea. The utility of large sea as water resources reservation base seems to have some prospects. If the realization of this concept is possible, then the contribution to the solution of water shortage can be expected not only in Japan but all over the world. For selecting the proposed building sites of marine reservation base, it is necessary to know the place where the ground water flows out or the place of snow water discharged into the ocean. In this study, pilot projects which analyze seashore ground water which flows out of Shimabara Peninsula and snow water which flows into the Ishikari Bay from Ishikari River, were carried out using satellite remote sensing techniques. The satellite data used in the former study were LANDSAT/TM (Thematic Mapper) data, the latter uses VTIR (Visible and Thermal Infrared Radiometer) and MESSR (Multispectral Electronic Self-Scanning Radiometer) data from MOS-1 (Marine Observation Satellite-1). Next, the reservation method together with the advantaged points and effectiveness of seashore ground water and snow water reservation is mentioned. The utilization of marine-reserved water resources was developed for life and industrial use, Ocean Thermal Energy Conversion (OTEC) use, mitigation of food shortage and so on. Finally, a method for detecting seashore ground water was designed using MOS-1/MESSR combined with a small submarine and an underwater television camera.

Author (NASDA)

N92-23029# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS OF THE THIRD SYMPOSIUM ON MOS-1 VERIFICATION PROGRAM (MVP), NO. 2

Mar. 1990 466 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 27 Feb. - 1 Mar. 1989 Original contains color illustrations

(JTN-92-80306) Avail: CASI HC A20/MF A04

Papers concerning the Marine Observation Satellite-1 (MOS-1) are presented. The following topics are addressed: the MOS-1 Verification Program, radiometers, MESSR (Multispectral Electronic Self-Scanning Radiometer), MSR (Microwave Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), remote sensing, remote sensors, spatial resolution, antenna radiation pattern, modulation transfer function, point spread function, radiometric characteristics, image processing, atmospheric correction, geometric correction, brightness temperature, radiance, computer compatible tape, radiances, sea surface temperature, timber identification, vegetation identification, snow cover identification, sea ice identification, landslide observation, cloud observation, land cover classification, and ocean currents observation.

Author (NASDA)

N92-23030# Kanazawa Inst. of Tech. (Japan). Lab. of Information Science.

THE ESTIMATION OF ATMOSPHERIC SCATTERING AND TOPOGRAPHIC EFFECTS ON THE MOS-1 IMAGERY

YOSHIYUKI KAWATA, TAKASHI KUSAKA, ATSUHISA OHTANI, and HITOSHI KUBO / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 1-13 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A04

The atmospheric scattering effect on the image data measured by the MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) is estimated. The basic algorithm which converts the measured satellite-level radiance data into the ground albedo data in a flat terrain case is presented. In this conversion the values of relevant atmospheric parameters such as the optical thickness, the single scattering albedo, and the turbidity factor of the atmosphere were adopted from a model atmosphere given by LOWTRAN 6 code in the evaluation of scattering and transmission functions. Lambert's law was assumed as a bidirectional reflection at the ground surface. Then, the classification for such ground albedo data was performed. It was found that the atmospheric correction has little effect on the overall classification accuracy for a single data set. But, when the classified maps are looked at carefully, favorable changes in category in the map based on the ground albedo data set can be detected. Then simple radiometric correction methods which remove both the atmospheric and topographic effects from the MOS-1 MESSR data over a rugged terrain are proposed. They were applied to a mountainous test site with known digital terrain data. Both of the Lambert's and Minnaert's laws were examined as a bidirectional reflection at the mountain slopes. It has been found that the Minnaert's law gives better results than the Lambert's law.

Author (NASDA)

N92-23031# National Research Inst. for Pollution and Resources, Tokyo (Japan).

THE INFLUENCE OF ATMOSPHERE AND SOLAR RADIANCE ON MESSR

OSAYUKI YOKOYAMA, MASAYASU HAYASHI, KOJI KITABAYASHI, SUSUMU YAMAMOTO, KISABURO NAKATA, and SHOICHI TAGUCHI / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 14-19 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

The MESSR (Multispectral Electronic Self-Scanning Radiometer) onboard MOS-1 (Marine Observation Satellite-1) is discussed. Satellite detected radiances were compared among bands obtained at the same area of Kashimanada on 2-3 Dec. 1987. The ratios of radiance among four bands changed during these days, which suggests a difference of optical properties of aerosols. Next, the satellite detected radiances were also compared with radiances simulated by LOWTRAN 6. This study reveals that the detected radiance was more than 50 percent larger than that calculated for Band 1. The discrepancies between the observation and the simulations for Band 2 and 3 were less than 50 percent. The detected radiances for Band 4 were more than twice as large as that of the simulation. The discrepancy in Band 1 is

caused by ignorance of multiple scatter. It was found that the horizontal distribution of aerosols is detectable as long as relative humidity and surface reflectance are given.

Author (NASDA)

N92-23032# National Inst. for Environmental Studies, Tsukuba (Japan).

A STUDY ON EVALUATION OF ATMOSPHERIC EFFECT ON MULTISPECTRAL ELECTRONIC SELF-SCANNING

RADIOMETER (MESSR) DATA BY SPECTRAL MEASUREMENT U@04SASANO, YASUHIRO@05HAYASHIDA, SACHIKO

Y. YASUOKA, T. MIYAZAKI, Y. IIKURA, Y. SASANO, and S. HAYASHIDA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 20-28 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

Atmospheric parameters were estimated by three different methods to evaluate the atmospheric effect on the MESSR (Multispectral Electronic Self-Scanning Radiometer) data. The atmospheric transmittance and the path radiance were estimated from a set of radiance data which were the upward radiance measured above water surface and the radiance detected by the MESSR at the corresponding points. Also the transmittance was estimated from the measurement of direct solar radiation. Further the transmittance was estimated from the laser radar data.

Author (NASDA)

N92-23033# Institute of Physical and Chemical Research, Saitama (Japan). Earth Science Lab.

RETRIEVAL OF WATER QUALITY PARAMETERS FROM RADIANCE DETECTED BY MESSR

SHIGEHICO SUGIHARA and MOTOAKI KISHINO / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 29-35 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

It is difficult to estimate water quality parameters such as chlorophyll concentration in surface water from the radiance collected by the MESSR (Multispectral Electronic Self-Scanning Radiometer) of the MOS-1 (Marine Observation Satellite-1) because of the low CCT (Computer Compatible Tape) counts over the water and also inclusion of the path radiance which acts as noise in estimating the water quality parameters. For water rich in phytoplankton, however, the radiance emerging from below the water surface is large and estimation of chlorophyll concentration might be possible. In order to test the possibility for estimating the chlorophyll concentrations in Lake Kasumigaura from the MOS-1 MESSR data, atmospheric transmittance and the sky radiance were observed to estimate the path radiance on November 7, 1988. In addition, chlorophyll concentrations were determined directly in the sampled surface waters. After the removal of the path radiance, chlorophyll concentration was estimated. Since the correlation between observed and estimated concentrations is good, chlorophyll concentration can possibly be determined from the MESSR data collected over the rather turbid waters.

Author (NASDA)

N92-23034# National Research Inst. for Pollution and Resources, Tokyo (Japan).

EVALUATION OF SPECTRAL RADIANCE OF INLAND SEA WATER IN MOS-1 MESSR IMAGES

MASAMITSU ONITSUKA, KAZUYUKI OHTA, and TSUYOSHI SAMUKAWA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 36-44 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

An extraction method for water color by use of a MOS-1 (Marine Observation Satellite-1) data set was studied. This method contained two major parts, the reduction of path radiance from the original data and decomposition from the upward intensities just above the sea surface to x_{10} , y_{10} , and z_{10} components. From the MOS-1 data set, the water color for the center part of Tokyo Bay was estimated with the set of values $x_{10} = 0.29$, $y_{10} = 0.33$, and $z_{10} = 0.38$, which shows that the MOS-1 data set

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contained considerable amounts of light reflected from the sea surface. The numbers of the water color index were estimated by use of Band 1 and Band 2 data, as follows: $N(\text{sub } C) = -25.01 + 86.88(0.360)L_0(\text{Band } 1) + 0.679(L_0(\text{Band } 2)/L_0(\text{Band } 1) + L_0(\text{Band } 2))$; $N(\text{sub } D) = -24.25 + 85.70(0.360)L_0(\text{Band } 1) + 0.679(L_0(\text{Band } 2)/L_0(\text{Band } 1) + L_0(\text{Band } 2))$, where $N(\text{sub } C)$ and $N(\text{sub } D)$ were the numbers of water color with respect to the C light source and D65 light source, respectively. $L(\text{sub } 0)(\text{Band } 1)$ and $L(\text{sub } 0)(\text{Band } 2)$ represented the intensities of Band 1 and Band 2 after path radiance correction. Author (NASDA)

N92-23035# Hirosaki Univ. (Japan). Dept. of Earth Sciences.
ACCURACY OF THE ESTIMATES OF SEA SURFACE TEMPERATURE BY THE MOS-1 INFRARED RADIOMETER
KUNIO RIKIISHI and HIDEO YAMASHITA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 45-51 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A04

Estimates of the sea surface temperature by the MOS-1 (Marine Observation Satellite-1) infrared radiometer are compared with the in situ observations of research vessels. An empirical relation between the brightness temperature and in situ observation is obtained as $T = (1.20(T_3) - 2.87) + 0.76(T_3 - T_4)$, where T_3 and T_4 are brightness temperatures through the windows of Channel 3 and 4, respectively, and T is the in situ observation. The temperature determined by the empirical relation has a probable error of ± 1.12 C. This may be explained by the following: the resolution of temperature by the MOS-1 radiometer is 0.5 C; the brightness temperature is a measurement of the skin layer to a depth of a few micrometers while the in situ observation is that of the surface layer to a depth of about 1 m; and the observational time and place of satellite imagery do not exactly coincide with those of ship surveys. Author (NASDA)

N92-23036# Far Seas Fisheries Research Lab., Shimizu (Japan). Oceanography and Southern Ocean Resources Div.
VERIFICATION FOR WATER MASS ANALYSIS RELATED TO FISH ECOLOGY AND FISHING GROUND FORMATION
SATSUKI MATSUMURA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 52-85 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) images were discussed in terms of their use for water mass analysis by a fisheries scientist. Coastal water distribution patterns could be clearly seen using Band 4 and Band 5. Compared to the LANDSAT MSS (Multi Spectral Scanner), the range of the radiative resolution of the MESSR is slightly higher than that of the MSS. However, any difference in radiance could not be seen in off-shore waters. After the air correction, no significant change was seen because the difference of aerosol density is deemed to be small in comparison with the radiative resolution. Verification for the DCS (Data Collection System) of MOS-1 was also done in the Bering Sea. Although the Bering Sea area is almost at the useful performance limit for the DCP (Data Collection Platform), the EOS (Earth Observation Satellite) could catch the signal and calculate the position. The DCP buoy was onboard the R/V (Research Vessel). This led to a positioning accuracy of 3 - 5 km. In practical terms, this is a significant value. Author (NASDA)

N92-23037# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanic Fisheries Dept.
MEASUREMENT OF THE UNDER WATER TEMPERATURE USING MOS-1 DCP
AKIRA KUROIWA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 86-107 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

In successful fishing operations, it is useful for fishermen to have access to information about variations in ocean conditions, such as water temperatures and currents. The onboard oceanic data collection system for fisheries (DCP-7 (Data Collection

Platform-7)), which collects data concerning underwater temperatures from the vessel and relays the data to the land station through MOS-1 (Marine Observation Satellite-1) DCS (Data Collection System), is discussed. The underwater temperature data measured by XBT (Expendable BathyThermograph), were formalized codes of eight frames and transmitted automatically to MOS-1 from DCP-7. The investigation of this system was implemented to evaluate the difference between the data directly measured onboard and the data recorded by the system, DCP-7. Author (NASDA)

N92-23038# National Research Inst. of Fisheries Engineering, Tokyo (Japan). Engineering Fisheries Agency.
STUDY ON DRIFTING-DATA COLLECTION BUOY USING MOS-1
EIICHI IMANARI, AKIO IKEDA, KOUICHI SAWADA, and YOSHIMI TAKAO / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 108-132 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

Until just recently, it was said that new fishing ground and untouched resources for the benefit of fisheries have to be dug up. But nowadays, it can be said that the growth of fisheries is to control the fishing ground and resources. Therefore it is necessary to investigate more exactly, more extensive marine information to control them. In Japan the first marine observation satellite, named MOS-1 (Marine Observation Satellite-1), was launched with expectation at February 19, 1987. So Drifting-type Data Collection Buoy (DDCB) with a link in the chain of MOS planning were designed. This report describes an outline of this buoy and result of experiment for verification using MOS-1. Author (NASDA)

N92-23039# Maritime Safety Agency, Tokyo (Japan). Hydrographic Dept.
STUDY ON DATA COLLECTION SYSTEM
YOSIZO UENO and TAJI IMOTO / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 133-142 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A04

The capacity of the data collection system on the performance of the satellite MOS-1 (Marine Observation Satellite-1) was examined. Error of positioning, available distance for data transmission and limited distance for positioning, were examined by sending wave data observed with drifting buoy which had been manufactured. Consequently, the smallest error of positioning was 5 m, the largest one was 1,120 m and positioning errors were within 600 m. Limited distance for data sending was measured by sending data from buoy to the moving vessel. The longest distance for receiving data was about 4,020 km. It was shown that the position was calculated within about 3,000 km. Author (NASDA)

N92-23040# Tokyo Univ. (Japan). Ocean Research Inst.
ON THE MEASUREMENT OF THE UNDERWATER AMBIENT NOISE BY MOS-1 DCS
JIRO SEGAWA (Tokyo Univ. (Japan).), HIROMI FUJIMOTO (Tokyo Univ. (Japan).), and TOSHIHARU KAKIHARA (Tokyo Univ. of Fisheries, Japan) / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 143-177 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

Two sets of drifting buoys with hydrophones for MOS-1 (Marine Observation Satellite-1) DSC (Data Collection System) verification program were developed. The tests of these drifting buoys were made at five coastal or offshore areas of Noto Peninsula, Kamaishi, Kochi, Amakusa, and Oki Islands in summer 1988. The tracking and recovery of the buoy and collection of underwater ambient noises was successful. It was found from the observations, that the spectra of the ambient noise have in general the negative slope against the frequency at each area and that the levels of the noise reveal the locality affected by the sound environments surrounding the observation site. In the coastal sea areas, the observation area of Kochi, for instance, the ship traffic noise and man-made noise was prominent. On the other hand, the wind

dependent noise was found at offshore site where the noise level is lower because of less contamination by the ship traffic noise. The noise caused by the noise measuring instrument itself is also mentioned. Author (NASDA)

N92-23041# Meteorological Satellite Center, Tokyo (Japan).

ESTIMATION OF CLOUD PARAMETERS USING MULTI-CHANNEL DATA

AKIYOSHI MITA, MASAMI TOKUNO, KAZUhide YAMAMOTO, and KAZUO SEKINE / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 178-193 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A04

Cloud analysis was performed by using MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer), MSR (Microwave Scanning Radiometer) and MESSR (Multispectral Electronic Self-Scanning Radiometer) data. For VTIR data, discriminant analysis of cloud types was carried out using the data for summer and winter, respectively, and reasonable results were obtained. As for MSR data, comparisons with weather radar data were made to see the capability to discern precipitating clouds over the ocean. Using MESSR data, fine horizontal structure of clouds was investigated, and an attempt was made to estimate the cloud top height of cumuliform clouds. However, the applicability of MSR and MESSR data to meteorological analysis is limited due to their narrow scene coverage. Author (NASDA)

N92-23042# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

COMPARISON OF DIFFERENT SENSOR DATA AND CHARACTERISTICS OF CIRRUS CLOUD

KIYOSHI TSUCHIYA, MASAMI TOKUNO, TAKASHI ISHIYAMA, MASAO MATSUMOTO, and RYUTARO TATEISHI / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2 p 194-206 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

Taking advantage of MOS-1 (Marine Observation Satellite-1) capability of simultaneous observation of a same target with different sensors, following studies are made: (1) effects of a sub-pixel cloud; (2) radiative characteristics of cirrus and cumulus clouds; and (3) applicability of water vapor band data of VTIR (Visible and Thermal Infrared Radiometer). It was found that an extremely thin cirrus above the sea can be effectively identified in the high gain mode data of MESSR (Multispectral Electronic Self-Scanning Radiometer) Band 1 and Band 2 while fairly difficult in Band 3 and Band 4 data. Influence of a small cumulus on IR (Infrared) channel extends beyond the size of cumulus perhaps due to a resampling procedure. The effect of a very thin cirrus on the visible channel of VTIR is small, however it gives an effect on TBB (Black Body Temperature) of Channel 3 as large as -1.5 C which is significant for sea surface temperature estimation. The data of water vapor channel of VTIR is useful to obtain water vapor distribution and location of a jet stream axis.

Author (NASDA)

N92-23043# Meteorological Research Inst., Tsukuba (Japan).

AN INVESTIGATION OF THE BIAS ERROR IN THE OBSERVED BRIGHTNESS TEMPERATURE OF VTIR

TADAO AOKI, KIYOTAKA SHIBATA, YOSHINARI MIZUNO, MASASHI FUKABORI, and TERUO AOKI / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 202-206 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A01/MF A04

VTIR (Visible and Thermal Infrared Radiometer) observed brightness temperatures have been compared with the theoretical calculations in the high latitudinal region of winter season. The purpose of this comparison is to check whether a bias error is contained in the observed brightness temperature. It has been found that at least in the limited number of comparisons there is no systematic discrepancy between the theoretical values and the observations. Author (NASDA)

N92-23044# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

ANALYSIS OF SHADOWING EFFECTS OF THE EARTH'S SURFACE USING MESSR DATA

HIROSHI OKAYAMA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 207-216 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

When the shadowing effects are applied to MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data, the path radiance and the skylight components are removed. As the training areas the Yufutsu open plain area near Tomakomai and the plain area around the Saroma Lake of Abashiri in Hokkaido were selected. The variation of the band ratio of data corrected using the shadowing effects are larger than those obtained when the shadowing effects are not considered. Therefore it is thought that in the analysis of the remote sensing information if the shadowing effects are used, the classification and discrimination of the object are made effectively. Author (NASDA)

N92-23045# Tokai Univ., Shizuoka (Japan). School of Marine Science and Technology.

OCEAN COLOR INFORMATION RETRIEVAL ON MESSR DATA

YASUHIRO SUGIMORI, HAJIME FUKUSHIMA, and SHIN FUJITA / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 217-225 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A04

In attempting to extract ocean color data from MESSR (Multispectral Electronic Self-Scanning Radiometer), two aspects, correction or removal of atmospheric effect and estimation of phytoplankton pigment concentration, are discussed. The study first investigates applicability of the Gordon Clark atmospheric correction scheme which has been widely accepted and used for NIMBUS-7/CZCS (Coastal Zone Color Scanner) data processing. Also discussed is expected error in pigment estimation due to the quantization. The performance is compared with that of LANDSAT Thematic Mapper data. It is pointed out that future sensors should be equipped with an observation band in shorter wave length region to attain enough sensitivity for phytoplankton pigments in open ocean. Author (NASDA)

N92-23046# Japan Marine Science and Technology Center, Tokyo. Marine Research and Development Dept.

EVALUATION OF ATMOSPHERIC EFFECT ON IMAGE OF VTIR

KEI MUNEYAMA, ICHIO ASANUMA, and YASUNORI SASAKI / In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 226-263 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A04

Equations of the atmospheric correction for a practical observation of sea surface temperatures by MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) were obtained for the day and night observation from data observed simultaneously by VTIR and a research vessel. Sea surface temperatures obtained with the atmospheric correction showed that the data of VTIR are useful for the practical oceanography, and compared with that is obtained by AVHRR (Advanced Very High Resolution Radiometer) on NOAA-10. Image qualities of VTIR and AVHRR were compared, where both data were obtained with two hours difference, on the warm core ring off Sanriku. A difference of sensors showed a different response on line profiles along a warm core ring and current. It is expected for VTIR to have higher resolutions in temperature and higher response in sensor for the middle scale oceanography as in warm core rings or in the Kuroshio warm current. Author (NASDA)

N92-23047# Ministry of Posts and Telecommunications, Kashima (Japan). Kashima Space Research Center.

MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR

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YUJI OHSAKI (Ministry of Posts and Telecommunications, Kashima (Japan).) and MASAHARU FUJITA (Radio Research Labs., Tokyo, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 264-277 Mar. 1990 *In* JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

An algorithm for estimation of rain rate from MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) data, previously developed on the basis of the radiative transfer theory, is examined in comparison with the rain rate data observed by the weather radar of the Japan Meteorological Agency on the top of Mt. Fuji. The MSR brightness temperature has been related to the radar-derived rain rates. There exists considerable scatter in the comparison between the rain rates derived from the MSR brightness temperature and from the radar measurements. This may partly be attributable to the non-uniform distribution of rain in the MSR FOV (Field of View). Problems in accurate estimation of rain rate with future satellite-borne microwave radiometers are also pointed out.
Author (NASDA)

N92-23048# Chiba Univ. (Japan). Dept. of Electronic Engineering.

MOS-1 MESSR IMAGE QUALITY ANALYSIS. PART 3: TIME SERIES CHANGE

YOSHIZUMI YASUDA, HUA QI, and YASUFUMI EMORI *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 278-291 Mar. 1990 *In* JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

This paper describes about the assessment of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data in terms of the time series change of MTF (Modulation Transfer Function), noise, and average CCT (Computer Compatible Tape) level, utilizing the three MOS-1 imageries of Tokyo Bay. The method of edge spectra ratio was used to drive MTF. Noise was analyzed using a FFT (Fast Fourier Transformation) technique on a flat sea area. And average CCT levels were computed on the largest common area over the three scenes. As a result, no change occurred in MESSR's spatial resolution performance. The same noise pattern appeared in all three scenes. Radiometric correction process cannot correct the noise formed by the different sensitivity or off-set in even and odd number elements in the CCD (Charge Coupled Device) line sensor; conversely it produces new noise in some cases. Geometric correction processes produce the horizontal fringe noise. Average CCT level relatively decreased about 20-25 percent in Channel 1, 2, and 3 during the first year after the launch and did not change in the second year.
Author (NASDA)

N92-23049# Naruto Univ. of Education (Japan).

PROBLEMS OF SEA MEASUREMENT BY MOS-1 MESSR AND THEIR BETTERMENT

AKIRA KIKUCHI (Naruto Univ. of Education (Japan).), OMATU SIGERU (Naruto Univ. of Education (Japan).), TOSIO KITAMURA (Naruto Univ. of Education (Japan).), SHIGEKI ISAWA (Tokushima Prefectural Fisheries Experimental Station, Naruto (Japan).), and MIKI OGURO (Tokushima Prefectural Fisheries Experimental Station, Naruto, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 292-303 Mar. 1990 *In* JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

In Seto Inland Sea, red tide is a serious problem and causes a great deal of damage to young yellow fish that breed every summer. The red tide is a phenomenon of the rapid growth of phytoplanktons. The phenomenon of the sea color as seen in MESSR (Multispectral Electronic Self-Scanning Radiometer) images is easily recognized. However, there are three problems for the analysis of red tide when using MOS-1 (Marine Observation Satellite-1) MESSR images: (1) matching image data and sea truth data when cloudy; (2) extraction of spectral characteristics of phytoplanktons by using four spectral images of MESSR with six bits; and (3) elimination of horizontal stripe noise in low level sea area of MESSR, which is caused by the cubic convolution

procedure. In this report, the improvement of these problems is considered. A restoration algorithm of the periodical noisy image in the third problem is constructed.
Author (NASDA)

N92-23050# Japan Weather Association, Tokyo. Meteorological and Environmental Investigation and Management Center.

COMPARISON OF MOS-1 VTIR DATA AND NOAA AVHRR DATA IN REFERENCE TO THERMAL AND SPATIAL RESOLUTION

MASATSUNA KOGA (Chiba Univ. (Japan).), SEIICHI SAITOH (Chiba Univ. (Japan).), HIROSHI KOKAI (Chiba Univ. (Japan).), YOSHIZUMI YASUDA (Chiba Univ. (Japan).), KEINOSUKE GOTO (Shimizu System Inst., Hokkaido (Japan).), and MASAO SHIMIZU (Shimizu System Inst., Hokkaido, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 304-315 Mar. 1990 *In* JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A04

MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data is compared with NOAA-9 AVHRR (Advanced Very High Resolution Radiometer) data with special reference to thermal and spatial resolution. In this study, two data sets gathered on June 1, and October 28, 1987 are employed. Both MOS-1 VTIR and NOAA-9 AVHRR data were gathered on the same day. There is a time lag of 5 hours between each data set. Therefore, sea surface temperature is used for the comparison between two data sets. As a result, the thermal resolution of MOS-1 VTIR Channel 3 is estimated about 0.6 C.
Author (NASDA)

N92-23051# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.

UTILISATION OF MOS-1 DATA IN EUROPE

L. FUSCO and G. M. PINNA *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 316-334 Mar. 1990
Avail: CASI HC A03/MF A04

This paper reviews the activities related to the MOS-1 (Marine Observation Satellite-1) data exploitation in Europe. At first, the European users' needs and the potential applications in Europe of MOS-1 data are summarized. Then, the European MOS-1 data system is described. Details of MOS-1 data acquisition, archiving, cataloging, processing, user services and products availability are given. Finally, the status and near future plans on the European MOS-1 Data Utilization Program (EMDUP) are presented.
Author (NASDA)

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MESSR IMAGE QUALITY

P. HENRY and G. BEGNI *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 335-347 Mar. 1990
Avail: CASI HC A03/MF A04

During the whole SPOT program, CNES (Centre National d'Etudes Spatiales) has used methods to check the SPOT image quality. The same methods have been applied to MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) images in order to assess their image quality performances, both from the radiometric and geometric points of view. The following performances have been studied: (1) image dynamics; (2) radiometric resolution, including detector noise, residual equalization noise, and global signal to noise ratio; (3) control of structural noise; (4) Modulation Transfer Function (MTF); (5) band to band registration; (6) locating accuracy; and (7) length distortion.
Author (NASDA)

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MOS-1 ABSOLUTE CALIBRATION USING SPOT1 AS AN INTERMEDIATE RADIOMETER

P. HENRY and G. BEGNI *In* NASDA, Proceedings of the Third

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Symposium on MOS-1 Verification Program (MVP), No. 2, p 348-359
Mar. 1990

Avail: CASI HC A03/MF A04

The on-board absolute calibration systems for earth observation satellites should be backed up by ground-based measurements. P. N. Slater has developed and routinely uses an absolute calibration procedure over the White Sands Desert, New Mexico, U.S.A. This procedure, however, cannot be directly used for MOS-1 (Marine Observation Satellite-1) since the calibration area is not in the visible range of any observation center. A secondary site (without any ground measurements) was used for a simultaneous MOS-1 and SPOT-1 observation. Using SPOT-1 as an intermediate radiometer, the White Sands measurements were transferred to the secondary test site. This allowed a MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) to achieve absolute calibration. An error budget was made in order to determine the method accuracy. Author (NASDA)

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RESULTS OF MOS-1 MSR, VTIR, AND MESSR DATA QUALITY EVALUATIONS AT NASA

ROY W. SPENCER, GARY J. JEDLOVEC, and ROBERT J. ATKINSON /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 360-370 Mar. 1990

Avail: CASI HC A03/MF A04

An evaluation of the Microwave Scanning Radiometer (MSR), the Visible and Thermal Infrared Radiometer (VTIR) and the Multispectral Electronic Self-Scanning Radiometer (MESSR) on the Japanese Marine Observation Satellite-1 (MOS-1) has been performed. Data from all three instruments have been analyzed using image processing systems at NASA's Marshall Space Flight Center (MSFC). Analysis of the MOS-1 orbital parameters and the MSR, VTIR, and MESSR scan geometries allow the use of software developed for the Man-computer Interactive Data Access System (MIDAS) at MSFC to navigate and re-map these data into different projections and to display them with other data bases at the same time. Most of the evaluation concentrated on data quality but potential applications of the sensor data were investigated. The data were of good quality and met many of the pre-launch requirements and specifications. Several relatively minor problems were noticed in the data from all three of the instruments. These problems were not severe and in most cases did not significantly restrict application of the data. Author (NASDA)

N92-23055# National Oceanic and Atmospheric Administration, Washington, DC. National Environmental Satellite, Data and Information Service.

USE OF MARINE OBSERVATION SATELLITE-1 IN APPLIED OCEAN SCIENCE

ROBERT A. WARNER and WILLIAM G. PICHEL /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 371-372 Mar. 1990

Avail: CASI HC A01/MF A04

The objective of this study is to examine data from the three sensors onboard the MOS-1 (Marine Observation Satellite-1) satellite from an oceanographic data user's viewpoint for ocean science applications. This study is to take the fundamental first steps in evaluating MOS-1 sensors for applied ocean color, temperature, and to estimate the location of ice edges. This preliminary work in comparing the MOS-1 sensors to other satellite sensors and to available reference data is presented, and an overview on the hardware and software personal computer system used in this study is presented. Author (NASDA)

N92-23056# Canada Centre for Remote Sensing, Ottawa (Ontario).

PRELIMINARY EVALUATION OF TYPICAL CANADIAN SCENES OF MOS-1 IMAGERY

M. MANORE and T. BUTLIN /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p

376-386 Mar. 1990

Avail: CASI HC A03/MF A04

The Marine Observation Satellite-1 (MOS-1) imaged selected parts of Canada during the spring, summer, and fall of 1988. The areas imaged were the sites of ongoing remote sensing experiments and, thus, a great deal of ancillary information is available to assist in the evaluation of the MOS-1 imagery. All the imagery was cataloged and is accessible in quicklook form on analog video disk or on VHS video tape to the Canadian MOS-1 Project Team. In addition, uncorrected computer compatible tapes were made of the several typical, well understood scenes to assist in determining the processing steps that will be required before the data can be used by team members to evaluate the use of the MOS-1 imagery for agriculture, forestry, geology, oceanography, and sea ice. The evaluation of this uncorrected imagery is discussed.

Author (NASDA)

N92-23057# National Research Council, Bangkok (Thailand). Remote Sensing Center.

MVP ACTIVITIES IN THAILAND

SUVIT VIBULSRETH, DARASRI SRISAENGTHONG, and CHANCHAI PEANVIJARNPONG /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 387-392 Mar. 1990

Avail: CASI HC A02/MF A04

This paper describes Thailand's activities in MOS-1 (Marine Observation Satellite-1) Verification Program (MVP). The National Research Council of Thailand (NRCT) and Thai government agencies from remote sensing data user community have conducted verification of MOS-1 data for various disciplines. Other activity to support of the MVP is the reception of MOS-1 data not only for Thai Principal Investigators (PI's) and but also for other PI's in Southeast Asia. Author (NASDA)

N92-23058# Korean Inst. of Energy and Resources, Seoul (Republic of Korea).

EVALUATION OF MOS-1 DATA FOR GEOLOGIC APPLICATION: LINEAMENT INTERPRETATION

PIL-CHONG KANG and KWANG-HOON CHI /in NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 393-404 Mar. 1990

Avail: CASI HC A03/MF A04

The study was focused on the applicability of the MOS-1 (Marine Observation Satellite-1) data for lineament interpretation and mineral deposits such as gold, silver, copper, lead, zinc, tungsten, and clay minerals connecting with the lineaments which were interpreted on the MOS-1 images. The lineaments interpreted on the MOS-1 image are 2156 in number, and major trends of those are N65 deg E, N15 deg E, N85 deg W, and N25 deg W. In general, the mineral deposits in the study area are related with lineaments, that is, the Cu, Zn, and Pb deposits are distributed more in the area where the 25 deg and 155 deg trend lineaments are concentrated and pyrophyllites are mainly emplaced along the N20 deg - 30 deg E trend lineaments. The result is different from the previous study (1976, Kim), that is, the lineaments interpreted on MOS-1 are more in number than those of LANDSAT MSS (Multi-Spectral Scanner) (1976), and also the predominant trends are different from the previous study (1976). Such differences might be due to spatial resolution and the image scale difference which is used in both cases. The MOS-1 data can be enlarged more than LANDSAT MSS data for practical application.

Author (NASDA)

N92-23059# Korea National Maritime Police, Incheon (Republic of Korea).

STUDY ON SURFACE OCEAN TEMPERATURE AND OCEAN COLOR DISTRIBUTION IN THE MID-WEST COASTAL WATERS OF KOREA

CHANG-SUP LEE (Korea National Maritime Police, Incheon (Republic of Korea).), JUNG-KEE CHOI (Korea National Maritime Police, Incheon (Republic of Korea).), KWANG-HOON CHI (Korea Inst. of Tech., Tae-Jon (Republic of Korea).), and PIL-JONG KANG (Korean Inst. of Energy and Resources, Seoul, Republic of Korea)

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In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 405-411 Mar. 1990
Avail: CASI HC A02/MF A04

An attempt was made to derive sea water turbidity of the Yellow Sea by analyzing Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self-Scanning Radiometer (MESSR) band 2 imagery and sea surface temperature by analyzing MOS-1 Visible and Thermal IR Radiometer (VTIR) band 3 imagery. The sea water turbidity data derived from satellite imagery was compared and checked with the ground truth data collected from the test sites. Ground truth data for the sea surface temperature were not available so the digital count of the satellite data was density sliced and displayed in color to present the relative temperature difference.
Author (NASDA)

N92-23060# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Land Use Planning Div.

STUDY ON SUGARCANE AND RICE FOR YIELD ESTIMATION
MANU OMAKUPT, DAMRONG BUAPRADABKUL, ANUSORN CHANTANAROJ, and SUTHEP CHUTIRATANAPHANT *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 412-421 Mar. 1990
Avail: CASI HC A02/MF A04

The objectives of MOS-1 (Marine Observation Satellite-1) Verification Program for Land Development Department in Thailand is to investigate sugar cane and rice area in Suphan Buri Province to estimate yield. The MESSR (Multispectral Electronic Self-Scanning Radiometer) CCT (Computer Compatible Tape) data, photoproduct was analyzed by a Dixip computer system. Combined with the ground truth data, the preliminary sugar cane and rice area map was produced. Furthermore, crop production estimation was conducted by visual interpretation of the aerial photographs and MESSR photoprint of the selected test site.
Author (NASDA)

N92-23061# Royal Forest Dept., Bangkok (Thailand). Remote Sensing and Data Collection in Forestry Center.

APPLICATION OF MOS-1 DATA FOR CLASSIFICATION OF FOREST RESOURCE

BOONCHANA KLANKAMSORN and THONGCHAI CHARUPATT *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 422-436 Mar. 1990
Avail: CASI HC A03/MF A04

The Royal Forest Department received MOS-1 (Marine Observation Satellite-1) data from NASDA (National Space Development Agency of Japan) in November 1988. The visual interpretation and image analysis were conducted in December 1988. MOS-1 data were verified for forestry applications in January 1989. The results of this study revealed that MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) data can be used for classification of existing forest and non-existing forest areas in Thailand. Moreover, mangrove forest areas can be classified from other forest types. In some areas, if evergreen and dry dipterocarp forest types occur in widely spread areas, they can be classified by using the help of bioclimatic and physiographic factors.
Author (NASDA)

N92-23062# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Dept. of Agriculture.

THE APPLICATION OF MOS-1 DATA TO MONITOR THE ENCROACHMENT OF SUGAR CANE PLANTATION INTO RICE FIELDS OF WEST CENTRAL PLAIN AREA

P. PIYAPONGSE (National Inst. for Agricultural Science, Tokyo (Japan).), E. HANSAKDI, T. AKIYAMA, and Y. YAMAGATA (National Inst. of Agro-Environmental Science, Ibaraki, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 437-441 Mar. 1990
Avail: CASI HC A01/MF A04

Sugar cane is an important economic crop of Thailand. The area allotment of each planting season has always created very serious problems between the sugar cane planters and sugar manufactures in the study areas, due to the production capacity of each of the refineries. In a productive year, the price of sugar

cane drops remarkably, causing serious problems for the planters. The use of MOS-1 (Marine Observation Satellite-1) data proved to be a promising method to detect the encroachment of sugar cane plantation into rice fields. The results of 1987-88 data indicated the encroachment of about three to five percent in the study area compared to area planted in 1985. A spectroradiometer would yield very satisfactory results in supporting the MSS (Multi Spectral Scanner) and MESSR (Multispectral Electronic Self-Scanning Radiometer) satellite's data.
Author (NASDA)

N92-23063# National Univ. of Singapore.

VERIFICATION ACCURACY OF GEOPHYSICAL VALUES

YEAN JOO CHONG *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, p 442-449 Mar. 1990
Avail: CASI HC A02/MF A04

MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) scene ID 10594-03152 (path 38 row 118 W, October 5, 1988) was been investigated. The scene covers the southern end of the Straits of Malacca, as well as areas in Indonesia, Malaysia, and Singapore. The CCT (Computer Compatible Tape) were processed on a computer. Unsupervised classifications were carried out. Data for sub-scenes were down loaded on to an PC-AT compatible microcomputer and the images were displayed on the microcomputer color monitor using enhanced graphics. The images show urban, industrial, agricultural, and forested areas. These images may be of use to those concerned with the environmental problems of reservoirs and their water catchment areas; of a protected area for migratory birds; and of land newly reclaimed from the sea.
Author (NASDA)

N92-23465# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS ON MOS-1 DATA EVALUATION

KOREHIRO MAEDA, ed. and S. OGAWA, ed. Mar. 1990
352 p *In* ENGLISH and JAPANESE Original contains color illustrations
(HE-90015; JTN-92-80274) Avail: CASI HC A16/MF A03

Topics addressed include: Japanese spacecraft, marine observation satellite, satellite observation, spacecraft performance, earth observing system, remote sensing, remote sensors, radiometers, image processing, image analysis, imaging technology, satellite imaging, image reconstruction, signal processing, infrared scanner, microwave radiometers, signal processing, geodetic survey, earth observation, rainfall measurement, snow cover, brightness temperature, antenna radiation patterns, and ice reporting.
Author (NASDA)

N92-23466# National Space Development Agency, Saitama (Japan). Earth Observation Center.

OUTLINE OF UTILIZATION RESULTS OF MOS-1 DATA

KOREHIRO MAEDA and HIDEO SATOH *In* its Proceedings on MOS-1 Data Evaluation p 1-12 Mar. 1990
Avail: CASI HC A03/MF A03

Marine Observation Satellite-1 (MOS-1) and MOS-1b were launched in 1987 and 1990, respectively. MOS-1 data are now received by 11 ground stations in the world. National Space Development Agency of Japan (NASDA) conducted the MOS-1 Verification Program (MVP) in collaboration with domestic and foreign investigators in order to evaluate the MOS-1 observation system from various points of view. As a part of MVP, the utility of MOS-1 data in various application fields including earth environment has been evaluated. In this paper, fields of utilization are classified into three categories (ocean, land, and atmosphere). An outline of utilization results are presented.
Author (NASDA)

N92-23467# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR

YUJI OHSAKI and MASA HARU FUJITA *In* NASDA, Proceedings

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on MOS-1 Data Evaluation p 13-16 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A01/MF A03

An algorithm for estimation of rain rate from Marine Observation Satellite-1 (MOS-1) Microwave Scanning Radiometer (MSR) data was developed. To investigate the performance of this algorithm, the rain rates estimated from MSR were compared with rain rates observed by the weather radar on the top of Mount Fuji with the reduction of the effect of the nonuniform distribution of rain in the MSR Field Of View (FOV). The correlation between the MSR and radar rain rates was fairly good, so the availability of the rain observation by MSR could be confirmed. The estimation of rain rate by MSR, however, is limited to the area over the ocean. The measurements of the area over the ocean, but near from the land, is not available because of the effect of the noise from land detected by the MSR antenna sidelobe. So, there is a need to do a comparative study using the rain area over the ocean located far from land. But the accuracy of rain observation by the radar depends on the range of the radar antenna to rain, so the quality on the radar data is not constant by the range. For the next step of the comparative study, it is planned to get the data of Satellite-derived Index (SI) of precipitation intensity. SI is designed to estimate the rain rate from Geostationary Meteorological Satellite (GMS) data. Author (NASDA)

N92-23468# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION, 3

MASAO TAKABE, TOSHIKAZU ITABE, and TADASHI ARUGA /In NASDA, Proceedings on MOS-1 Data Evaluation p 17-25 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

This paper will report some preliminary results of the Marine Observation Satellite-1 (MOS-1) verification research using a ground-based laser beacon. An earth laser beacon is observed from space as a point similar to a bright star. Thus, the spot image of a laser beacon is very useful for calibration/correction of the earth's surface image taken by optical radiometers or cameras, since it corresponds to an infinitively small land mark whose absolute location and brightness are known precisely. The experiments of tracking the MOS-1 and transmitting a laser beam from a ground station at Communications Research Laboratory (CRL) to the satellite have been conducted. Currently an argon ion laser is used as a beacon, and images taken by the Multispectral Electronic Self Scanning Radiometer (MESSR) are analyzed for this study. As the results of analysis, at first a tendency of the MOS-1 location error obtained from the optical tracking is shown. Then the geometric error of the MESSR earth images and the satellite's attitude estimated from two dimensional coordinates of the laser spot and the scene center, are shown.

Author (NASDA)

N92-23469# Tokai Univ., Tokyo (Japan). Research and Information Center.

ESTIMATION OF MTF OF MOS-1 MESSR IMAGES

TOSHIBUMI SAKATA, HARUHISA SHIMODA, and KIYONARI FUKUE /In NASDA, Proceedings on MOS-1 Data Evaluation p 26-51 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

A Modulation Transfer Function (MTF) of Multispectral Electronic Self Scanning Radiometer (MESSR) image was estimated using an edge spectrum ratio method. This method was applied to vertical and horizontal edges in several MESSR images. The Effective Instantaneous Field Of View's (EIFOV) were obtained from the estimated MTF. The average values of obtained EIFOV's are 71-75 m and 77-78 m for tracking and scanning directions, respectively. As the result of evaluation for EIFOV's, the following conclusions were obtained: (1) Seasonal changes of atmospheric condition effects on EIFOV are about 4 m on average and about 10 m as maximum; (2) A difference of EIFOV between the system-1 and 2 is nothing; (3) Atmospheric effects on EIFOV were estimated as 29 m, 24 m, 21 m and 11 m for each channel, respectively;

(4) It is estimated, after consideration of the intrinsic performance of MESSR, that the movement of platform increases 14 m (15 percent) of EIFOV.

Author (NASDA)

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INVESTIGATIONS ON VERIFICATION OF THE DATA OBSERVED BY THE MESSR AND VTIR, AND ON INTERANNUAL TREND IN THE MSR DATA

AKIRA SHIBATA, YOSHIO SHINOHARA, and KENZO SHUTO /In NASDA, Proceedings on MOS-1 Data Evaluation p 52-63 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

Performance of the Microwave Scanning Radiometer (MSR) is estimated by using the data in the period May 1987 through November 1989. The difference r.m.s. (root mean square) between the accumulated water vapor content obtained by the MSR and aerological observations is 2.3 kg per sq meter for Chichijima Island, and 2.9 kg per sq meter for Hachijo Island. Those data are excluded in which the accumulated liquid water content observed by the MSR is larger than 0.8 kg per sq meter. In those cases, it becomes difficult for the MSR to estimate the water vapor content accurately, because the microwave is scattered by both rain drops and ice crystals. Several causes for the difference r.m.s. are estimated, including the natural and mechanical ones. Correction coefficients, such as antenna pattern, bias, polarization, and land emission, are shown, which are used in transforming the antenna temperature into the brightness temperature.

Author (NASDA)

N92-23471# Meteorological Research Inst., Tsukuba (Japan). Meteorological Satellite and Observation Research Div.

VERIFICATION OF MESSR AND VTIR, AND TIME VARIATION OF MSR PERFORMANCE

YOZO TAKAYAMA, TSUTOMU TAKASHIMA, KAZUHIKO MASUDA, and AKIO KUROSAKI /In NASDA, Proceedings on MOS-1 Data Evaluation p 64-70 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

Accuracy in radiation measurement by Visible and Thermal Infrared Radiometer (VTIR) Band 2 was examined by using the relation between water vapor density and observed brightness temperature of the band. In comparison between estimated and observed data, the method could avoid uncertainty in water vapor distribution. The result shows no discrepancy between the predicted relation and the observed one. The relation could apply to analysis of water vapor distribution. For utilization of VTIR sea surface temperature (SST), an image was made and compared with a ten day mean surface temperature map which was based on ship measured SST. The patterns were matched, showing a temperature difference of about 1 C.

Author (NASDA)

N92-23472# University of Electro-Communications, Tokyo (Japan).

SIGNAL PROCESSING OF THE DATA OBTAINED BY MOS-1 MSR

KAZUHIKO MORITA, IKUO ARAI, and TSUTOMU SUZUKI /In NASDA, Proceedings on MOS-1 Data Evaluation p 71-91 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

This paper describes new techniques to improve the accuracy in data from the Marine Observation Satellite-1 (MOS-1) Microwave Scanning Radiometer (MSR). The error correction is processed by an inversion technique to the polarization, side lobes and foot print of the MOS-1 MSR antenna. The error due to unwanted brightness radiation from upper atmosphere is also considered. The result shows that the corrections on the data around Japan are feasible as to the brightness temperatures which are corrected about 20 K and 10 K on the land and sea area, respectively.

Author (NASDA)

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N92-23473# Forestry and Forest Products Research Inst., Ibaraki (Japan). Remote Sensing Lab.

EVALUATION OF EFFECTIVE CHARACTERISTIC IN FOREST FIELD

HARUO SAWADA, OSAMU NAKAKITA, KUNIKO HASEGAWA, and YOSHIO AWAYA / In NASDA, Proceedings on MOS-1 Data Evaluation p 92-99 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

Outline of results of evaluation of Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self Scanning Radiometer (MESSR) for forest resource management in Peninsula Malaysia is presented. Training areas, two hill-forests, swampy forest, and mangrove forest were formed from four images. Their statistics and cluster-classes were calculated. The result was that there were 6 to 11 classes in forestry and the range of visible channel was small. Vegetation indices should be applied (it was discussed in the first report) for tropical forestry of this time. In result, it seems to suggest that vegetation indices show covering ratio of vegetation. Vegetation indices about zoning of forestry were used and satisfactory results were obtained. Author (NASDA)

N92-23474# Institute of Disaster and Earth Sciences, Tokyo (Japan).

VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR IN THE FIELD OF DISASTER PREVENTION

SHIGETSUGU UEHARA, KAZURO NAKANE, SHINOBU YAZAKI, and TOSHIKAZU MOROHOSHI / In NASDA, Proceedings on MOS-1 Data Evaluation p 100-108 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

This study includes analysis on three different kinds of disasters to verify the effectiveness of Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self Scanning Radiometer (MESSR). The first is an analysis on the relationship between flooded areas and their geomorphological features to a MESSR image around Dhaka of Bangladesh taken on 17 October 1988. The second is an analysis to delineate the fallen ash covered areas due to the eruptions of Aso Volcano using a MESSR data taken on 18 October 1989. The third is an analysis to make clear the topographical features and patterns of erosion over a MESSR image of Loess Plateau in China. The following results were obtained: (1) A MESSR image around Dhaka was very effective to delineate various micro geomorphological features; (2) The analysis to delineate the fallen ash was fairly difficult; and (3) Topographical features of the erosion of the Loess Plateau were enhanced using differential operator to each of the band images. The near infrared bands are more effective to enhance the features due to thin brightness of vegetation covered areas than visible ones. Author (NASDA)

N92-23475# Meteorological Satellite Center, Tokyo (Japan).

ESTIMATION OF SEA SURFACE TEMPERATURES USING MOS-1, GMS, AND NOAA

HIDEYUKI SASAKI, YOSHISHIGE SHIRAKAWA, and YOSHIAKI TAKEUCHI / In NASDA, Proceedings on MOS-1 Data Evaluation p 109-118 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

Sea Surface Temperatures (SST'S) are estimated by using four regression methods of two satellites, namely two methods using Marine Observation Satellite-1 (MOS-1) Visible and Thermal Infrared Radiometer (VTIR) data and two of NOAA-9 (National Oceanic and Atmospheric Administration-9) Advanced Very High Resolution Radiometer (AVHRR) and Television Infrared Observation Satellite (TIROS) Operational Vertical Sounder (TOVS). The satellite-derived SST are compared with in-situ measured SST. The result shows that (1) Root Mean Square (RMS) errors of four methods are not so different, and (2) bias errors are minus for MOS-1's two methods and plus for NOAA's two methods. The comparison of the calibration of five infrared sensors, MOS-1/VTIR (Band 3 and 4), IR channel of Geostationary Meteorological Satellite-3 (GMS-3) and GMS-4 and NOAA-10/AVHRR shows that

VTIR Band 3 and 4 are calibrated with the accuracy of less than 1 C. Author (NASDA)

N92-23476# Maritime Safety Agency, Tokyo (Japan). Hydrographic Dept.

MONITORING OF OCEAN CONDITIONS BY USING MOS-1 DATA

MASATAKA HISHIDA, HIROYUKI YORITAKA, HARUO ISHII, MINORU ODAMAKI, TOORU TSUKAMOTO, and SATOSHI SATO / In NASDA, Proceedings on MOS-1 Data Evaluation p 119-145 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A03

Availability of Marine Observation Satellite-1 (MOS-1) data for mapping of sea surface temperature, transparency, ocean color and discolored water discharged from submarine volcanos was examined. Results of the study are as follows: (1) MOS-1 Multispectral Electronic Self Scanning Radiometer (MESSR) and Visible and Thermal Infrared Radiometer (VTIR) data (black and white film, Computer Compatible Tape (CCT)) were compared with observed ocean conditions (rough pattern of ocean conditions was observed by MESSR data, but fine structure was not. Sea surface temperature was decided from VTIR data with the precision of about + or - 1 C in consequence of comparison with in-situ data, so that only general pattern of sea surface temperature was observed); (2) Discolored water discharged from submarine volcano 'FUKUTOKU OKA NO BA', which was observed from an airplane, was examined using MESSR data (however, it was not detected from color print, but was dimly detected from black and white film (Low Gain Mode); and (3) Accordingly, in a sea area, MESSR should be operated in High Gain Mode, so that its usefulness will be expanded for ocean observation. Author (NASDA)

N92-23477# Japan Fisheries Information Service Center, Tokyo.

STUDY OF MOS-1 MESSR DATA FOR VARIABILITY OF THE BRANCH (WARM STREAMER) FROM WARM EDDY AND FOR FISHING GROUND

HIDEO TAMEISHI, OSAMU HONDA, YOSHIHIRO OKADA, TOSHIYUKI KOUUGUCHI, and KEIICHI IWATA / In NASDA, Proceedings on MOS-1 Data Evaluation p 146-154 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

In the second Symposium on Marine Observation Satellite-1 (MOS-1) Verification Program (MVP), the application of MOS-1 data for forecasting the fishing ground of the Skipjack was reported. Also, in the third Symposium the relationship between the MOS-1 Multispectral Electronic Self Scanning Radiometer (MESSR) Data and Coastal fishing ground was studied. In this study, the relationship between fine structure of warm eddy and fishing ground was investigated by using the MOS-1 Visible and Thermal Infrared Radiometer (VTIR) data with referring aircraft data. The following interesting results were obtained: (1) MOS-1 VTIR imagery can represent the Warm Streamer and it is recognized that the spatial resolution accuracy (2.7 km) is enough to appreciate the fine structure; (2) By use of the simultaneous aircraft data, it is found that the many schools of sardine are distributed at the head of Warm Streamer; and (3) It seems that the Warm Streamer is useful for the transfer of schools toward the north. Author (NASDA)

N92-23478# Toba Merchant Marine Coll. (Japan).

APPLICABILITY OF MESSR AND VTIR DATA FOR MARINE OBSERVATION Report No. 3

HIROAKI OCHIAI / In NASDA, Proceedings on MOS-1 Data Evaluation p 155-161 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A03

Using the data obtained by Marine Observation Satellite-1 (MOS-1), the applicability of Multispectral Electronic Self Scanning Radiometer (MESSR) and Visible and Thermal Infrared Radiometer (VTIR) data for monitoring of marine environment was evaluated and several remarkable results were carried out as follows: (1) The water characteristics in Ise Bay in hottest season is well

identified by color sliced imagery produced from Band-1 and Band-4 of MESSR; (2) The sea surface temperature distribution pattern around Kuroshio Current and surrounding area in Kumanonada is recognized as very well in color sliced imagery of Band-4 of VTIR; and (3) In comparison with hydrographical data collected by ship, both MESSR and VTIR data were concluded as very effective for marine observation especially in coastal areas. Author (NASDA)

N92-23479# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

RETRIEVAL OF UPPER PRECIPITABLE WATER PROFILE FROM MOS-1 VTIR WATER VAPOR CHANNEL

MASAO MATSUMOTO, SHIGEYUKI TAKASAKI, and KIYOSHI TSUCHIYA /in NASDA, Proceedings on MOS-1 Data Evaluation p 162-169 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A03

The retrieval method of precipitable water profile within the range from top of the atmosphere to 500 millibar from Marine Observation Satellite-1 (MOS-1) Visible and Thermal Infrared Radiometer (VTIR) water vapor channel is proposed. The precipitable water profile is retrieved by maximum likelihood solution of linearized radiative transfer equation which represents radiation conservation of layered atmosphere. Up to 35 percent of root mean square error of the estimation occurred. The difference between observed brightness temperature ($T_{sub\ b}$) and calculated $T_{sub\ b}$ through LOWTRAN 7 application of computer program is about 10 K. Computed value is lower than that provided by Earth Observation Satellite (EOS), which difference is the main cause of estimation error. For more precise analysis, it is necessary to check overall function of VTIR together with absorption characteristics of radiation by H₂O in the spectrum of VTIR water vapor channel. Author (NASDA)

N92-23480# National Research Inst. of Fisheries Engineering, Tokyo (Japan). Marine Productivity Div.

UTILIZATION OF SATELLITE IMAGES FOR MARINE RESOURCES

DENZO INAGAKE and AKIRA TOMOSADA /in NASDA, Proceedings on MOS-1 Data Evaluation p 170-174 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A01/MF A03

A lot of small scale sea surface phenomena are detected by satellite images. Since these phenomena are believed to play important roles in the formation of structures that can be used to determine the concentration, the distribution, and the movement of fish schools, it was tried to identify those structures and their roles for fisheries resources. Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self Scanning Radiometer (MESSR) high gain data were analyzed to identify the mechanism for the concentration of Shirasu which are the larvae of sardines. The MESSR high gain data show a number of lines on the sea surface at the south of Atsumi peninsula in 25 Aug. 1989. One of these lines has a shape that is similar to the distribution of the Shirasu fishing grounds. Therefore, it is considered that these phenomena, which can be detected by the MOS-1 MESSR, are important for the distribution of Shirasu schools. It is necessary to study the generative mechanism of these lines by oceanographic observation and to make clear the mechanism of the concentration of Shirasu schools using MOS-1 MESSR high gain data. Author (NASDA)

N92-23481# National Inst. of Polar Research, Tokyo (Japan). PRELIMINARY REPORT ON THE OBSERVATION OF POLAR ATMOSPHERE AND CRYOSPHERE BY MOS-1 DATA RECEIVED AT SYOWA STATION

TAKASHI YAMANOUCHI, FUMIHIKO NISHIO, MAKOTO WADA, HIROSHI KANZAWA, and SADAOKAWAGUCHI /in NASDA, Proceedings on MOS-1 Data Evaluation p 175-188 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A03

The multipurpose satellite data receiving system (11m antenna) has received data from the Marine Observation Satellite-1 (MOS-1) since Feb. 1989. The MOS-1 data has enabled the analysis of

cloud liquid water content and water vapor amount, derivation of sea ice information and concentration, and monitoring of the ice sheet edge. Using images from the MOS-1 processed data, applicability of the data to the research subject is examined. Multispectral Electronic Self Scanning Radiometer (MESSR) imagery is applicable to the monitoring of the ice sheet edge. The Visible and Thermal Infrared Radiometer (VTIR) supplies important data to observe synoptic and large scale meteorology. However, the detection of clouds over snow and ice surfaces is difficult, especially in polar night. One of the main uses for the Microwave Scanning Radiometer (MSR) data is to survey the condition and distribution of the sea ice. However, the data is affected by the atmospheric liquid water and water vapor, and may result in large estimation errors of the sea ice concentration. It is difficult to derive the liquid water and water vapor concentration from these data over snow or ice covered surfaces. Author (NASDA)

N92-23482# Hokkaido Inst. of Tech. (Japan).

AVAILABILITY OF MSR DATA FOR SNOW WATER ESTIMATION

MASAHIRO SUZUKI (Hokkaido Inst. of Tech. (Japan).), MASAMI SASAKI (Hokkaido Inst. of Tech. (Japan).), KAZUO FUJINO (Hokkaido Univ., Sapporo (Japan).), and TOSHIYUKI KAWAMURA (Hokkaido Univ., Sapporo, Japan) /in NASDA, Proceedings on MOS-1 Data Evaluation p 189-196 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A03

Using the brightness temperature obtained by the Microwave Scanning Radiometer (MSR) onboard the Marine Observation Satellite-1 (MOS-1), at the frequencies of 23.8 and 31.4 GHz, a comparison between data and ground truth data related snowpack parameters in the Hokkaido area was carried out. The availability of MSR data for the estimation of snowpack parameters was discussed, and several factors which had effects on the accuracy of estimation were investigated. The results indicate that, at the present stage, the remote sensing of snowpacks by MOS-1 MSR is useful for the macroscopic estimation of annual snowcover in a region such as Hokkaido, which has a complex configuration of landcover and snow characteristics. Author (NASDA)

N92-23483# Nagaoka Technological Univ., Niigata (Japan).

OBSERVATION OF LINED-UP CUMULUS ROWS UNDER THE WINTER MONSOON SITUATION USING MOS-1 AND RADAR DATA

TOSHIO KOIKE (Nagaoka Technological Univ. (Japan).), HIROSHI UEDA (Hokkaido Univ., Sapporo (Japan).), and YASUSHI FUJIYOSHI (Hokkaido Univ., Sapporo, Japan) /in NASDA, Proceedings on MOS-1 Data Evaluation p 197-203 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A02/MF A03

The distribution of snow clouds in the coastal regions of Hokkaido and Hokuriku was observed by a combination of the Marine Observation Satellite-1 (MOS-1) and radar on 28 Dec. 1988 and 25 Jan. 1990, respectively. In the Hokkaido region, the longitudinal perturbation was in a preferred mode. The cloud top temperature distributions, using VTIR (Visible and Thermal Infrared Radiometer) data, are consistent with the snow fall distribution predicted by radar data. Radar reflectivity was strong in the high cloud top area. In the Hokuriku region, snow clouds were in the transverse mode. The cloud top temperature decreased over land due to the orographic effect. The strong reflectivity area appeared on the windward side of the cloud center. The water vapor and cloud liquid content data, obtained using the Microwave Scanning Radiometer (MSR), cannot be compared with radar reflectivity data due to the strong land radiation effect. Author (NASDA)

N92-23484# Far Seas Fisheries Research Lab., Shimizu (Japan).

THE ACCURACY OF THE DRIFT BUOY POSITIONING BY MOS-1 DCS

TOSHIYA KISHIRO and SATSUKI MATSUMURA /in NASDA,

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Proceedings on MOS-1 Data Evaluation p 204-214 Mar. 1990
In JAPANESE; ENGLISH summary
Avail: CASI HC A03/MF A03

The positioning accuracy of the Marine Observation Satellite-1 (MOS-1) Data Collection System (DCS), in the North Pacific Ocean, was examined and compared with the Navy Navigation Satellite System (NNSS) and ARGOS. The differences between the positions of the drift buoy observed by MOS-1 DCS and by NNSS were about 5.4 km in the northward, and about 4.1 km in the eastward, respectively. The positions observed by MOS-1 DCS, NNSS, and ARGOS were distributed randomly within the range of about 5 km of each other. Distances between each position were within the range of systematic error of Doppler effect produced by moving of the Data Collection Platform (DCP).

Author (NASDA)

N92-23485# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanic Fisheries Dept.
RESEARCH PROJECT FOR PRACTICAL USAGE OF MOS-1 DATA COLLECTION SYSTEM

AKIRA KUROIWA /in NASDA, Proceedings on MOS-1 Data Evaluation p 215-222 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A03

It is necessary to study oceanographic activity to improve fishery production. The Study and System Evaluation Project of the Marine Observation Satellite-1 (MOS-1) placed a Data Collection Platform (DCP) onboard a vessel and measured the water temperature at various depths from 1986-1988. The feasibility of collecting, recording, and analyzing real-time data for use in fishing is studied. In addition, the project is further charged with evaluating the performance and practical utilization of the hardware used in the system from 1989-1991. In 1989, study was extended to the development of various sensors for oceanographic observations and to the improvement of compressed data transmission systems.

Author (NASDA)

N92-23486# National Research Inst. of Fisheries Engineering, Tokyo (Japan).

STUDY ON DRIFTING-DATA COLLECTION BUOY USING MOS-1: POSITION VERIFICATION IN THE BERING SEA

KOICHI SAWADA, YOSHIMI TAKAO, AKIO IKEDA, and EI-ICHI IMANARI /in NASDA, Proceedings on MOS-1 Data Evaluation p 223-230 Mar. 1990 In JAPANESE; ENGLISH summary
Avail: CASI HC A02/MF A03

It is useful to monitor the variation of the marine environment for the purpose of managing fisheries operations. Though it is effective to use satellites, it is difficult to obtain vertically distributed marine data, such as water layer temperature or salinity. A data collection buoy, which can collect the vertically distributed water temperature and salinity data, and which can send these data through the Marine Observation Satellite-1 (MOS-1) Data Collection System (DCS) to a land station, was developed. Large amounts of data are sent by dividing them into several sets. This makes it feasible to sample data in a wide area. A position verification experiment in the Bering Sea was performed. A transmitter was installed in a Hokuten trawler. The northern limit of the MOS-1 DCS and the receivable amount of data were examined at the limit. NASDA Earth Observation Center (EOC) estimated positions were compared with positions obtained every four minutes using the Navy Navigation Satellite System (NNSS) and LORAN C. The result is that ten data transmitting occasions per path at N 61 deg (W 175 deg) and five occasions at W 150 deg (N 59 deg) could be obtained.

Author (NASDA)

N92-23487# National Oceanic and Atmospheric Administration, Seattle, WA. Office of Research and Applications.

USE OF MARINE OBSERVATION SATELLITE-1 IN APPLIED OCEAN SCIENCE

WILLIAM G. PICHEL and ROBERT A. WARNER /in NASDA, Proceedings on MOS-1 Data Evaluation p 231-245 Mar. 1990
Avail: CASI HC A03/MF A03

The Marine Observation Satellite-1 (MOS-1) carries a unique

complement of instruments suited for ocean monitoring, particularly for the monitoring of sea ice. Three MOS-1 instruments are examined for their usefulness to ocean applications. Using a personal computer image display workstation, the Microwave Scanning Radiometer (MSR) data are compared to Special Sensor Microwave/Imager (SSM/I) data for ice concentration and ice edge position determination. The response of the MSR 31.4 GHz band is found to be comparable to that of the SSM/I 37 GHz band, and can be used for mapping sea ice under many conditions. The Visible and Thermal Infrared Radiometer (VTIR) and Multispectral Electronic Self Scanning Radiometer (MESSR) instruments are assessed for their utility in measuring sea surface temperature and ocean color, respectively.

Author (NASDA)

N92-23488# Universite Catholique de Louvain (Belgium). Remote Sensing Lab.

MULTITEMPORAL AND MULTISENSOR APPROACH WITH MOS DATA TO NATURAL RESOURCES EVALUATION IN DRY TROPICAL AFRICA (BURKINA FASO)

P. DEFOURNY, P. JACQUES, and J. WILMET /in NASDA, Proceedings on MOS-1 Data Evaluation p 246-262 Mar. 1990
Avail: CASI HC A03/MF A03

The possibilities offered by the generation of Marine Observation Satellite (MOS) with regard to the study of renewable resources in dry tropical regions are assessed. The first part of the study is devoted to the use of Multispectral Electronic Self Scanning Radiometer (MESSR) data for phenological monitoring and quantitative evaluation of woody vegetation. A comparison of rain and vegetation index distributions would suggest a close relationship between the two types of observation. Despite botanical observations, no correlation between woody vegetation cover and remote sensing information have been found for the end of dry season. Then, a comparison of the MESSR, Multispectral Scanner (MSS), and Thematic Mapper (TM) sensors has revealed that the high resolution of the MOS Satellite is particularly well suited to the study of sudano-sahelian agrarian systems. Finally, the integration of the two sensors MESSR and Visible and Thermal Infrared Radiometer (VTIR) were used for a discussion of methods for simulating coarse resolution data from high resolution data. The performances of VTIR in terms of spatial resolution have turned out to be of the same order as those of the Advanced Very High Resolution Radiometer (AVHRR) sensor.

Author (NASDA)

N92-23489# Indian Space Research Organization, Ahmedabad. Meteorology and Oceanography Div.

A NOTE ON DATA QUALITY: MSR DATA

P. N. PATHAK and N. GAUTAM /in NASDA, Proceedings on MOS-1 Data Evaluation p 263-269 Mar. 1990
Avail: CASI HC A02/MF A03

Under Marine Observation Satellite-1 Verification Program-91 (MVP-91), five data tapes containing Microwave Scanning Radiometer (MSR) data recorded at Bangkok were received during April 1989. The quality aspects of these MSR data have been examined in terms of image characteristics and the variations in the MSR radiometric counts. In view of the large variation observed in the basic radiometric counts, no further analysis was considered to be feasible.

Author (NASDA)

N92-23490# Indian Space Research Organization, Ahmedabad. Land Resources Div.

COMPARATIVE STUDY OF DIGITAL MOS-1 MESSR, LANDSAT MSS, AND IRS LISS-1 DATA FOR LAND COVER CLASSIFICATION IN SAMBALPUR DISTRICT, INDIA

V. K. DADHWAL and J. S. PARIHAR /in NASDA, Proceedings on MOS-1 Data Evaluation p 270-276 Mar. 1990
Avail: CASI HC A02/MF A03

The study was undertaken for evaluating the performance of the Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self Scanning Radiometer (MESSR) (4 Oct. 1988), the LANDSAT-5 Multispectral Scanner (MSS) (12 Oct. 1988), and the Indian Remote Sensing Satellite-1A (IRS-1A) Linear Imaging Scanning System-1 (LISS-1) (October 15, 1988) digital data for land cover classification

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over an intensive test site in Sambalpur district of Orissa State (India). MSS and LISS-1 data were registered on MESSR and subjected to supervised and unsupervised classification. Maximum likelihood (MXL) supervised classification for 27 training classes of eight major land-cover types gave highest overall mapping accuracy for LISS-1. In the unsupervised approach, pixels belonging to vegetation classes (agriculture, forest, and scrub) were clustered using Diday's algorithm with common input parameters. In this test, no sensor had consistently higher accuracy for all the classes. Statistical separability among the clusters of different classes was then compared using average divergence. LISS-1 had the highest separability while MESSR had a higher to similar divergence in comparison to MSS. Author (NASDA)

N92-23491# Indian Space Research Organization, Ahmedabad. Image Processing Systems Div.

DATA QUALITY EVALUATION RESULTS MOS-1 VERIFICATION PROGRAM

S. S. PALSULE, MRITUNJAY, B. S. SHAH, PUSHPALATA, H. S. BHATT, G. PASWAN, H. K. GARG, and C. V. S. PRAKASH
In NASDA, Proceedings on MOS-1 Data Evaluation p 277-303 Mar. 1990

Avail: CASI HC A03/MF A03

The Marine Observation Satellite-1 (MOS-1) was successfully launched from the Tanegashima Space Center of the National Space Development Agency of Japan (NASDA) by an N-2 Launch Vehicle in Feb. 1987. Study on performance of the Multispectral Electronic Self Scanning Radiometer (MESSR) was done under MOS-1 verification program (MVP). Some results of Data Quality Evaluation on the MOS-1 Computer Compatible Tape (CCT) have been presented, as part of Indian Space Research Organization's (ISRO) participation in MVP. The data acquired by Bangkok station was used in this analysis. Author (NASDA)

N92-23492# Indian Space Research Organization, Ahmedabad. Land Resources Div.

ESTIMATION OF REGIONAL EVAPOTRANSPIRATION WITH MOS-1 VTIR DATA

T. J. MAJUMDAR, S. S. POKHARNA, and A. K. KANDYA
In NASDA, Proceedings on MOS-1 Data Evaluation p 304-312 Mar. 1990

Avail: CASI HC A02/MF A03

A simplified model suggested by Soer (1980) has been used to estimate evapotranspiration (ET) over a part of Eastern India using Marine Observation Satellite-1 (MOS-1) Visible and Thermal Infrared Radiometer (VTIR) data. This data can be used to generate the surface albedo and surface temperature which are essential for the estimation of evaporation of a particular region of interest. Crop surface temperature gives information on the evaporation rate and on soil moisture conditions. Estimation of evaporation on a regional scale is useful in various ways. Firstly, latent heat of evaporation is used for solving energy balance equations and has implications in micrometeorological and agroclimatological studies. Secondly, it is useful in hydrology for estimation of water balances. Comparison of the ET map as obtained from MOS data shows similarity with the agricultural map. Changes in the contribution to evaporation, as one crosses from uncultivated land to an agricultural crop region and from land to water, are observed. Author (NASDA)

N92-23493# Indian Space Research Organization, Ahmedabad. Land Resources Div.

AN ATTEMPT TO DERIVE LAND SURFACE TEMPERATURES FROM MOS-1 VTIR DATA USING SPLIT-WINDOW CHANNEL COMPUTATION TECHNIQUE

T. J. MAJUMDAR
In NASDA, Proceedings on MOS-1 Data Evaluation p 313-324 Mar. 1990

Avail: CASI HC A03/MF A03

Marine Observation Satellite-1 (MOS-1) Visible and Thermal Infrared Radiometer (VTIR) multichannel thermal infrared data were utilized to compute the surface temperatures on land in different parts of Eastern India. Two existing models were used to derive surface temperatures. The split-window channel technique

employed here avoids the problem due to atmospheric water vapor perturbation. The technique followed here would essentially be valid in a noncloudy region. Author (NASDA)

N92-25620# National Space Development Agency, Tokyo (Japan).

INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: JERS-1 WORKSHOP

2 Nov. 1990 158 p *In* ENGLISH and JAPANESE Conference held in Ibaraki, Japan, 2 Nov. 1990

(JTN-92-80346) Avail: CASI HC A08/MF A02

The following topics were discussed: JERS-1 (Japanese Earth Resources Satellite-1), JERS-1 satellite verification program, remote sensing, remote sensors, earth resources survey, ice observation, SAR (Synthetic Aperture Radar), optical sensors, radiometers, ground stations, mission planning procedure, data acquisition, data reception, data processing, data transfer network, data distribution, JERS-1 data cataloging and archiving, JERS-1 project organization, and schedule of project.

Author (NASDA)

N92-25625# National Space Development Agency, Ohashi (Japan).

MISSION PLANNING PROCEDURE

TAKESHI NAGAI and ICHIROH NAITOH
In its International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 41-53 2 Nov. 1990

(EW-5) Avail: CASI HC A03/MF A02

Presented in viewgraph format, major tasks and characteristics of mission planning for JERS-1 (Japan Earth Resources Satellite-1), and user interface of JERS-1 are outlined. Topics addressed include: work flow of JERS-1 operation planning; major operation constraint of mission equipments; primary objective of data acquisition; observation request; catalogue information retrieval; data request; and data system for JERS-1 data distribution.

Author (NASDA)

N92-25626# National Space Development Agency, Ohashi (Japan).

VERIFICATION PROJECT

KOREHIRO MAEDA
In its International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 55-70 2 Nov. 1990

(EW-6) Avail: CASI HC A03/MF A02

Presented in viewgraph format, verification activities of JERS-1 (Japan Earth Resources Satellite-1) in NASDA (National Space Development Agency of Japan) are outlined. Topics addressed include: mission objectives of JERS-1 system; purpose of JERS-1 verification program; schedule of verification program; verification items; calibration of SAR (Synthetic Aperture Radar) on the JERS-1; and calibration of OPS (Optical Sensor) system on the JERS-1.

Author (NASDA)

N92-25629# Canada Centre for Remote Sensing, Ottawa (Ontario).

JERS-1 DATA APPLICATIONS IN CANADA

LEON BRONSTEIN
In NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 91-95 2 Nov. 1990

(EW-8(2)) Avail: CASI HC A01/MF A02

Presented in viewgraph format, an outline of Canadian earth observation programs utilizing JERS-1 (Japan Earth Resources Satellite-1) is described. Topics addressed include: coverage circles of observation from Prince Albert and Gatineau Satellite Stations; observation using CV-580 aircraft; utilization of data sets acquired from other satellites, ground scatterometer, airborne electrooptical imagery, and test sites; Canadian experiment teams; JERS-1 announcement of opportunity (A-O) and its options; Canadian A-O data requirement; and commercial access to JERS-1 data.

Author (NASDA)

43 EARTH RESOURCES AND REMOTE SENSING

N92-25630# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.

EUROPEAN SPACE AGENCY J-ERS1 STATUS

VINCENT BERUTI *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 97-100 2 Nov. 1990

(EW-9) Avail: CASI HC A01/MF A02

Presented in viewgraph format, status of ESA's (European Space Agency) activity in JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 is mentioned. Topics addressed include: memorandum of understanding between ESA and NASDA (National Space Development Agency of Japan); and JERS-1 upgrading status. Author (NASDA)

N92-25632# Tokai Univ., Tokyo (Japan). Research and Information Center.

UTILIZATION OF JERS-1 DATA

HARUHISA SHIMODA *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 113-118 2 Nov. 1990

(EW-11) Avail: CASI HC A01/MF A02

Presented in viewgraph format, the reception and use of JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 data is outlined. Topics addressed include: performance of JERS-1 and its sensor units; utilization of JERS-1 and ERS-1 data; land cover classification; vegetation classification; change detection; ocean observation; soil moisture detection; natural hazard detection; stereo image; and Synthetic Aperture Radar (SAR).

Author (NASDA)

N92-25633# National Inst. of Polar Research, Tokyo (Japan).

JERS-1 APPLICATION FOR SEA ICE, GLACIER, AND ICE SHEET

FUMIHIKO NISHIO *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 119-140 2 Nov. 1990

(EW-12) Avail: CASI HC A03/MF A02

Presented in viewgraph format, application of JERS-1 (Japan Earth Resources Satellite-1) and ERS-1 data to observe sea ice, glacier and ice sheet is presented. Topics addressed include: operational status of world earth observation satellites; SAR (Synthetic Aperture Radar) data requirement; characteristics of Optical Sensor (OPS) and SAR on the JERS-1; usefulness of SAR and other sensors compared under the glaciological regime; and sensor images of ice environment. Author (NASDA)

N92-25634# Earth Resources Satellite Data Analysis Center, Tokyo (Japan).

UTILIZATION OF SAR DATA FOR RESOURCES EXPLORATION

ATSUSHI IWASHITA *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 141-151 2 Nov. 1990 *In* ENGLISH and JAPANESE

(EW-13) Avail: CASI HC A02/MF A02

Presented in viewgraph format, utilization of Synthetic Aperture Radar (SAR) data for geological survey is outlined. Topics addressed include: analysis of SAR image over the tropical forest; edge density image; terrain detection; and rock type discrimination. Author (NASDA)

N92-25635# Geological Survey of Japan, Ibaraki.

UTILIZATION OF OPS DATA FOR RESOURCES EXPLORATION

RYOICHI KOUDA *In* NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 153-171 2 Nov. 1990

(EW-14) Avail: CASI HC A03/MF A02

Presented in viewgraph format, utilization of OPS (Optical Sensor) for geological survey is outlined. Topics addressed include: outline of data processing and analysis procedures for ASEAN (Association of Southeast Asian Nations) remote sensing Indonesian project; mineral exploration; edge detecting operators;

rock type discrimination; geologic map; geologic mapping; phase diagram; gravity measurement; and gold deposits.

Author (NASDA)

N92-25692# National Space Development Agency, Tokyo (Japan).

INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: ADEOS WORKSHOP

30 Oct. 1990 218 p Conference held in Ibaraki, Japan, 30 Oct. 1990

(JTN-92-80343) Avail: CASI HC A10/MF A03

Topics addressed include: outlines and status of the ADEOS (Advanced Earth Observing Satellite) Project, IMG (Interferometric Monitor for Greenhouse Gases) Project, ILAS (Improved Limb Atmospheric Spectrometer) Project, RIS (Retroreflector In-Space) Project, NSCAT (NASA Scatterometer) Project, TOMS (Total Ozone Mapping Spectrometer) Project, POLDER (Polarization and Directionality of the Earth's Reflectances) Project, AVNIR (Advanced Visible and Near Infrared Radiometer) Project, and OCTS (Ocean Color and Temperature Scanner) Project. An outline of ADEOS mission, NSCAT mission, POLDER/OCTS mission, and IMG mission, and the research plan for each sensor are also presented.

Author (NASDA)

N92-25693# National Space Development Agency, Tokyo (Japan). Earth Observation Satellite Group.

STATUS OF ADEOS PROJECT

NOBUO IWASAKI *In* its International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 9-18 30 Oct. 1990

(AW-2) Avail: CASI HC A02/MF A03

The ADEOS (Advanced Earth Observing Satellite) is a large earth observing satellite which carries two core sensors and six announce of opportunity (AO) sensors. The objectives of these sensors are global observation of land, ocean, and atmosphere. ADEOS has another mission to develop some technology required for the future platform era. Inter-Orbit Link (IOL) is one of them and will be established between ADEOS and ETS-6 (Engineering Test Satellite-6) for the first time in Japan, experimentally. After launching of the Communication and Broadcasting Engineering Satellites, all of the observation data of ADEOS will be transmitted by the IOL as a real time basis, demonstrating that IOL is a key technology for future platform era. ADEOS accommodates the conventional and reliable X band system also for the direct mission data transmission to the ground station. The science data from these sensors are properly multiplexed and recorded efficiently in the ADEOS to secure the global coverage. ADEOS is scheduled to be launched early 1995 by the H-2 launch vehicle from Tanegashima Space Center. NASDA (National Space Development Agency of Japan) has just started the ADEOS Phase C study.

Author (NASDA)

N92-25694# National Research Lab. of Metrology, Tokyo (Japan).

STATUS OF IMG PROJECT

AKIRA ONO *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 19-29 30 Oct. 1990

(AW-3) Avail: CASI HC A02/MF A03

The mission objectives and status of the IMG (Interferometric Monitor for Greenhouse Gases) Project for ADEOS (Advanced Earth Observing Satellite) are outlined in viewgraph form. The topics addressed include: mission requirements and configuration of IMG; IMC (Image Motion Compensation); FOV (Field of View); ADEOS path, development schedule of IMG; management system; and design concept. Author (NASDA)

N92-25695# National Inst. for Environmental Studies, Ibaraki (Japan). Global Environmental Dept.

STATUS OF ILAS/RIS PROJECT

YASUHIRO SASANO and KAZUYA ASADA *In* NASDA,

43 EARTH RESOURCES AND REMOTE SENSING

International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 31-48 30 Oct. 1990
(AW-4) Avail: CASI HC A03/MF A03

The mission objectives and status of ILAS (Improved Limb Atmospheric Spectrometer) and RIS (Retroreflector In Space) project for ADEOS (Advanced Earth Observing Satellite) are outlined in viewgraph form. The topics addressed include: background and objective of development for the ozone monitoring sensor; principle and function of ILAS and RIS unit; specifications of both the unit; development schedule; and ground station.

Author (NASDA)

N92-25696* National Aeronautics and Space Administration, Washington, DC.

STATUS OF NSCAT/TOMS PROJECT

G. F. ESENWEIN *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 49-53 30 Oct. 1990

(AW-5) Avail: CASI HC A01/MF A03

The status of the NSCAT (NASA Scatterometer) and TOMS (Total Ozone Mapping Spectrometer) Projects for the ADEOS (Advanced Earth Observing Satellite) which were developed as part of NASA Earth Probes Program are outlined in viewgraph form. The topics addressed include: objectives of NSCAT and TOMS sensor development; specifications of sensors; utilization of sensors for NIMBUS-7 satellite, ADEOS, and NROSS (Navy Remote Ocean Sensing System) satellite; and the status of PDR (preliminary design review) and CDR (critical design review) for sensors.

Author (NASDA)

N92-25697* Centre National d'Etudes Spatiales, Paris (France).

STATUS OF POLDER PROJECT

JEAN PIERRE DESHAYES *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 55-65 30 Oct. 1990

(AW-6) Avail: CASI HC A02/MF A03

The result of the Phase A study and the plan of the Phase B study for the ADEOS (Advanced Earth Observing Satellite) POLDER (Polarization and Directionality of the Earth's Reflectances) Project were described. The topics addressed include: an outline of POLDER; explanation of investigation fields utilizing POLDER; schedule of development; specifications; system architecture; principles of measurement; preliminary configuration; data processing center; conclusion of Phase A study; and decisions for Phase B study.

Author (NASDA)

N92-25698* National Space Development Agency, Tokyo (Japan). Earth Observation Program Office.

ACTIVITY OF ADEOS MISSION TEAM

KAZUO TACHI *In* its International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 67-73 30 Oct. 1990

(AW-7) Avail: CASI HC A02/MF A03

In 1989, NASDA (National Space Development Agency of Japan) set up the ADEOS (Advanced Earth Observing Satellite) data set study team chaired by Dr. Hirosawa, Institute of Space and Science in order to survey ADEOS data requirements and to study algorithms to obtain geophysical variables. This year, NASDA has organized the ADEOS Mission Teams composed of scientists. The objectives of the ADEOS Mission Teams are to make algorithms to produce final data set to make an instrument verification and validation plan, and to make a mission operation plan. Each mission team is primarily organized by the respective instrument provider or the sponsoring agency. NASDA will organize the Mission Coordination Board (MCB) to integrate the mission teams plans, coordinate intercalibration between instruments, to emphasize interdisciplinary study activity, and to promote ADEOS data use.

Author (NASDA)

N92-25699* Remote Sensing Technology Center, Tokyo (Japan).

DATA APPLICATION OF AVNIR

HAJIME KOSHIISHI *In* NASDA, International Conference on

Japanese Earth Observation Programs: ADEOS Workshop p 75-83 30 Oct. 1990

(AW-8) Avail: CASI HC A02/MF A03

The scientific features of AVNIR (Advanced Visible and Near Infrared Radiometer) sensor for the ADEOS (Advanced Earth Observing Satellite) and the mission of the AVNIR team are described. The mission is composed of a sensor performance study, an application study, an investigation on products, and a supporting study for the verification program. Expected data applications are the estimation of wave over sea and hydrology and vegetation. The topics addressed include: outline and characteristics of the AVNIR sensor; spatial resolution; image quality; radiometric performance; geometric distortion; stereoscopic performance; atmospheric effect on sensor performance; expected application study using sensor; investigation of products from AVNIR data; and the mission of the AVNIR study team.

Author (NASDA)

N92-25700* Far Seas Fisheries Research Lab., Shimizu (Japan).

DATA UTILIZATION PROGRAM OF ADEOS OCTS

SATSUKI MATSUMURA *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 85-93 30 Oct. 1990

(AW-9) Avail: CASI HC A02/MF A03

The purpose of OCTS (Ocean Color and Temperature Scanner) mission team and applications of the ocean color data are described in viewgraph form. The topics addressed include: the main purpose and the activity of OCTS mission team; user's target; application of ocean color data such as global scale studies of biogeochemical cycles, fisheries application, coupling of ocean color data with ecosystem models, and coastal environment study; data transmission; and requirements for sensor data quality.

Author (NASDA)

N92-25701* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

NASA SCATTEROMETER (NSCAT): DATA APPLICATION AND SCIENTIFIC CHALLENGES

MICHAEL H. FREILICH *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 95-109 30 Oct. 1990

(AW-10) Avail: CASI HC A03/MF A03

The application of NSCAT (NASA Scatterometer) data to ocean wind measurement is described in viewgraph form. The topics addressed include: scientific need and challenges for ocean wind measurement; examples of science investigations utilizing NSCAT; and outlines of investigations conducted by NASA NSCAT Science Team.

Author (NASDA)

N92-25702* Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

START OF THE ADEOS-NSCAT MISSION TEAM IN JAPAN

HARUNOBU MASUKO *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 111-125 30 Oct. 1990

(AW-11) Avail: CASI HC A03/MF A03

The issues of satellite scatterometry, related research, and requirements for NSCAT (NASA Scatterometer) data in Japan are described, and the Japanese NSCAT Mission Team and its principal purpose are introduced. The topics are addressed in viewgraph form and include: role of wind over the ocean in earth environment; wind scatterometry; wind speed measurement; principal purpose and member list for the Japanese ADEOS (Advanced Earth Observing Satellite) NSCAT Mission Team; utilization requirements of ADEOS-NSCAT data; requirements for data sets such as the signal level, resolution, quality, data distribution, and software; and the ocean experiment in the JERS-1 (Japan Earth Resources Satellite-1) Program.

Author (NASDA)

N92-25703* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.

TOMS SCIENCE OBJECTIVES AND PROJECT STATUS

43 EARTH RESOURCES AND REMOTE SENSING

A. KRUEGER *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 127-143 30 Oct. 1990

(AW-12) Avail: CASI HC A03/MF A03

The status of the TOMS (Total Ozone Mapping Spectrometer) Project is outlined in viewgraph form with emphasis on its data application to science. The topics addressed include: primary scientific goals of TOMS application; ozone research activities; volcano-climate research; total ozone trends; polar ozone changes; TOMS flight status; interim missions; contract status of ADEOS (Advanced Earth Observing Satellite) TOMS development; configuration of TOMS; and the result from NIMBUS-7 observation. Author (NASDA)

N92-25704# Tokyo Univ. (Japan). Geophysics Research Lab. **SCIENTIFIC PRODUCTS EXPECTED FROM THE TOMS DATA** TOSHIHIRO OGAWA *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 145-152 30 Oct. 1990

(AW-13) Avail: CASI HC A02/MF A03

The expected scientific products from the ADEOS (Advanced Earth Observing Satellite) TOMS (Total Ozone Mapping Spectrometer) data are presented in viewgraph form. The topics addressed include: global mapping of total ozone; global mapping of total sulfur dioxide; and global mapping of tropospheric ozone. Author (NASDA)

N92-25705# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

POLDER DATA APPLICATION

PIERRE Y. DESCHAMPS *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 153-166 30 Oct. 1990

(AW-14) Avail: CASI HC A03/MF A03

The expected applications of the ADEOS (Advanced Earth Observing Satellite) POLDER (Polarization and Directionality of the Earth's Reflectances) data are presented in viewgraph form. The topics addressed include: global survey of the biosphere and the atmosphere; ocean color observation; vegetation index; aerosols observation; radiative budget; clouds observation; water vapor content; schedule of POLDER products; and sensor calibration. Author (NASDA)

N92-25706# Meteorological Research Inst., Tsukuba (Japan).

POLDER/OCTS MISSION TEAM

TSUTOMU TAKASHIMA *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 167-195 30 Oct. 1990

(AW-15) Avail: CASI HC A03/MF A03

The polarization measurement is presented in viewgraph form with attention on the atmosphere and ocean system. The topics addressed include: objectives of the polarization measurement; the principle of the polarization measurement; the POLDER (Polarization and Directionality of the Earth's Reflectances) OCTS (Ocean Color and Temperature Scanner) research plan; outlines of polarization measurement conducted before; aerosol observation; phase function and polarization; radiance and polarization degree; and dependence of the radiation just above and below the ocean surface on atmospheric and oceanographic parameters. Author (NASDA)

N92-25707# Tokai Univ., Tokyo (Japan). Research and Information Center.

IMG MISSION TEAM

HARUHISA SHIMODA *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 197-219 30 Oct. 1990

(AW-16) Avail: CASI HC A03/MF A03

Outlines of the IMG (Interferometric Monitor for Greenhouse Gases) Project for the ADEOS (Advanced Earth Observing Satellite) and responsibilities of IMG Mission Team are presented in viewgraph form. The topics addressed include: mission objectives such as high accuracy measurement of earth radiation budget,

high accuracy measurement of temperature profiles, measurements of density profiles of CO₂ and H₂O, total ozone observation, and mixing ratio of CH₄, N₂O, and CO in the troposphere; specifications of the IMG such as spectral range, wave number resolution, wave number accuracy, S/N (Signal to Noise) ratio, absolute accuracy, stability, and so on; the IMG mission team responsibilities; outline of the IMG Science and Data Information System; mission operation and standard products of IMG; data quantity; and explanation of FT-IR (Fourier Transformation Infrared) spectroscopy and its utilization in the field of science. Author (NASDA)

N92-25708# National Inst. for Environmental Studies, Tsukuba (Japan).

ILAS/RIS RESEARCH PLANS: DATA APPLICATION

YASUHIRO SASANO *In* NASDA, International Conference on Japanese Earth Observation Programs: ADEOS Workshop p 221-244 30 Oct. 1990

(AW-17) Avail: CASI HC A03/MF A03

The principle and the purpose of the ILAS (Improved Limb Atmospheric Spectrometer) and RIS (Retroreflector In-Space) measurements are outlined in viewgraph form. The topics addressed include: the principle of the ILAS/RIS measurement; utilization of ILAS/RIS data; ILAS/RIS data retrieval; data level of the ILAS/RIS; framework of the ILAS data management; structure of the RIS reflector; ground station for RIS measurement; and introduction of the Center for Global Environmental Research (CGER) of Japan established on October 1990 at the NIES (National Institute for Environmental Studies). Author (NASDA)

N92-26046# National Space Development Agency, Tokyo (Japan).

INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: SYMPOSIUM ON MOS-1 DATA EVALUATION

31 Oct. 1990 426 p Conference held in Ibaraki, Japan, 31 Oct. 1990

(JTN-92-80344) Avail: CASI HC A19/MF A04

The following topics were discussed: specifications and performance of MOS-1b (Marine Observation Satellite-1b) components and onboard sensors; evaluation of sensors and its subsystem; evaluation of sensor data; image calibration; MSR (Microwave Scanning Radiometer); VTIR (Visible and Thermal Infrared Radiometer); MESSR (Multispectral Electronic Self-Scanning Radiometer); MTF (Modulation Transfer Function); utilization of MOS-1 sensor data; vegetative index; forestry management; land management; flood mapping; sea surface temperature; atmospheric sounding; application for oceanography, fisheries, and meteorology; and disaster prevention. All of the presentations are represented by viewgraphs only. Author (NASDA)

N92-26047# National Space Development Agency, Tokyo (Japan).

RESULT OF MOS-1B CHECKOUT

RYOTA SATO and MASATO TAKAHASHI *In* its International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 7-28 31 Oct. 1990

Avail: CASI HC A03/MF A04

This paper summarizes the result of MOS-1b (Marine Observation Satellite-1b) checkout. MOS-1b was launched from Tanegashima Space Center, NASDA (National Space Development Agency of Japan) by H-1 launch vehicle on February 7, 1990. Within two days, three-axis attitude was established. During the succeeding two months, the orbital performance of mission and bus subsystems was thoroughly checked out. The result of this checkout showed that the satellite performed satisfactorily. The presentation is in viewgraphs only. Author (NASDA)

N92-26048# National Space Development Agency, Ohashi (Japan).

OUTLINE OF MOS-1B COMPATIBILITY RESULTS

I. NAITO *In* its International Conference on Japanese Earth

43 EARTH RESOURCES AND REMOTE SENSING

Observation Programs: Symposium on MOS-1 Data Evaluation p 29-38 31 Oct. 1990

Avail: CASI HC A02/MF A04

National Space Development Agency of Japan (NASDA) launched Marine Observation Satellite-1 (MOS-1) completely on February 7, 1990. This report presents the results of the evaluation of MOS-1b processed image data. The accuracy of MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) distortion correction are evaluated by using satellite data. The above evaluations were accomplished satisfactorily, and the obtained results were concluded to be quite practical for the continuing progress of the operations of MOS data processing system. Author (NASDA)

N92-26049# National Space Development Agency, Ohashi (Japan). Earth Observation Center.

OUTLINE OF MOS-1 DATA EVALUATION

KOREHIRO MAEDA *In its* International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 39-50 31 Oct. 1990

Avail: CASI HC A03/MF A04

Marine Observation Satellite-1 (MOS-1) and MOS-1b were launched in 1987 and 1990, respectively. MOS-1 data are now received by 11 ground stations in the world. NASDA (National Space Development Agency of Japan) conducted MOS-1 Verification Program (MVP) in collaboration with domestic and foreign investigators in order to evaluate MOS-1 observations from various points of view. As a part of MVP, the utility of MOS-1 data in various application fields including earth environment has been evaluated. In 1989 FY (Fiscal Year), NASDA conducted MOS-1 evaluation with 20 domestic organizations. NASDA is also developing MOS-1 data set for both sea surface temperature and polar ice to prepare for ISY (International Space Year: 1992) in collaboration with related research organizations and plans to distribute to domestic organizations the MOS-1/MOS-1b data set for study. Fields of utilization are classified into three categories (ocean, land and atmosphere) and outline of evaluation results of MOS-1 data are presented. Author (NASDA)

N92-26050# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION Report No. 3

MASAO TAKABE, TOSHIKAZU ITABE, and TADASHI ARUGA *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 51-65 31 Oct. 1990

Avail: CASI HC A03/MF A04

An earth laser beam observed from space looks like a point similar to a bright star. Thus the spot image of a laser beam is very useful for calibration and correction of an earth's surface image taken by optical radiometers or cameras, since it corresponds to an infinitively small landmark whose absolute location and brightness are known precisely. Experiments were conducted that track the MOS-1 (Marine Observation Satellite-1) satellite and transmit a laser beam from a ground station at CRL (Communications Research Laboratory) to the satellite. Currently an argon ion laser is used as the beacon and the images taken by the MESSR (Multispectral Electronic Self-Scanning Radiometer) are analyzed for this study. As the results of analyses, first the tendency of the MOS-1 location error obtained from optical tracking is shown. Then the geometric error of the MESSR earth images and the satellite's attitude estimated from two dimensional coordinates of the laser spot and the scene center, are shown. Author (NASDA)

N92-26051# Ministry of Posts and Telecommunications, Kashima (Japan). Space Research Center.

MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR

YUJI OHSAKI and MASA HARU FUJITA *In* NASDA, International

Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 67-92 31 Oct. 1990

Avail: CASI HC A03/MF A04

A comparison is performed of rain rates retrieved from MSR (Microwave Scanning Radiometer) brightness temperature and those obtained from Satellite-derived Index of Precipitation Intensity (SI). SI is designed to estimate the rain rates from GMS (Geostationary Meteorological Satellite) measurements by Meteorological Satellite Center of Japan Meteorological Agency. Good correlation between these measurements is found. It is also found that the rain height is a key parameter for the measurement of rain rate with better accuracy than satellite-borne radiometer and that SI will be very useful to clarify the potential of rain measurements with a new microwave radiometer, such as the Special Sensor Microwave Imager. Author (NASDA)

N92-26052# Meteorological Research Inst., Tsukuba (Japan). Meteorological Satellite and Observation Research Div.

CALIBRATION AND UTILIZATION OF VTIR

YOZO TAKAYAMA *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 93-109 31 Oct. 1990

Avail: CASI HC A03/MF A04

To evaluate the quality of CH (Channel) 2 data, the brightness temperature (radiance spectrally averaged over weighting functions by filter transmittance distribution function) of CH 2 in a clear region is compared with calculated brightness temperature obtained by radiative transfer code and aerological data with the assumption of water vapor distributions in upper troposphere and stratosphere, and with consideration of radiosonde measurement error in relative humidity. The comparison suggests that both brightness temperatures agreed within the margin of error in relative humidity of radiosonde measurement. In the infrared spectral channels, it is concluded that VTIR (Visible and Thermal Infrared Radiometer) on MOS-1 (Marine Observation Satellite-1) satellite makes measurement of upwelling radiation sufficiently well. As an application of VTIR data to meteorology, sea surface temperature retrieval is examined and CH 2 data in clear area is analyzed. The root mean square temperature differences of sea surface temperature are 0.89 C for three channels algorithm, and 1.00 C for two channels algorithm, respectively. From the result of analysis of CH 2 data by using radiosonde data, in no aerological data area, it may be feasible to improve accuracy in an analysis of water vapor distribution used as an initial value for numerical weather forecast. Author (NASDA)

N92-26053# Meteorological Research Inst., Tsukuba (Japan).

STUDY OF ADVANCED MICROWAVE SCANNING

RADIOMETER BASED ON RESULTS OF MSR ABOARD MOS-1

AKIRA SHIBATA, KOREHIRO MAEDA, and YUJI OSAWA *In* NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 111-128 31 Oct. 1990

Avail: CASI HC A03/MF A04

Verification experiments of Microwave Scanning Radiometer (MSR) aboard Marine Observation Satellite-1 (MOS-1) launched in February 1987 show that MSR is capable of observing column water vapor over the ocean with an accuracy of 2 to 3 kg/sq m in the range between 5 and 60 kg/sq m. The observation is interrupted under rainy conditions, because the microwave is scattered by rain drop and ice crystal. A criterion for accurate observation is roughly determined that column liquid water is less than 0.8 kg/sq m, which may correspond to precipitation of a few millimeter per hour. Even though MSR has attained the performance determined at the design stage, it is revealed that MSR has several disadvantages. Therefore, advanced MSR which overcomes the disadvantages is presented. Author (NASDA)

N92-26054# Tokai Univ., Tokyo (Japan). Research and Information Center.

ESTIMATION OF MTF OF MOS-1 MESSR IMAGES

TOSHIBUMI SAKATA, HARUHISA SHIMODA, and KIYONARI FUKUE *In* NASDA, International Conference on Japanese Earth

43 EARTH RESOURCES AND REMOTE SENSING

Observation Programs: Symposium on MOS-1 Data Evaluation p 129-153 31 Oct. 1990

Avail: CASI HC A03/MF A04

An MTF (Modulation Transfer Function) of MESSR (Multispectral Electronic Self-Scanning Radiometer) image was estimated using an edge spectrum ratio method. This method was applied to vertical and horizontal edges in several MESSR images. The Effective Instantaneous Field of View (EIFOV) was obtained from the estimated MTF. The average values of obtained EIFOV's are 71 to 75 m and 77 to 78 m for tracking and scanning directions, respectively. As the result of evaluation for EIFOV's, the following conclusions were obtained: (1) Seasonal changes of atmospheric condition affect on EIFOV about 4 m as average and about 10 m as maximum; (2) A difference of EIFOV between the system-1 and 2 is 0; (3) Atmospheric effects on EIFOV were estimated as 29, 24, 21, and 11 m for each channel, respectively. But large variations of EIFOV among channels are not observed on images so that atmospheric effects and intrinsic performances of MESSR cancel each other; and (4) It is estimated after consideration of intrinsic performance of MESSR that the movement of platform increases 14 m (15 pct.) of EIFOV. Author (NASDA)

N92-26055# Ministry of Agriculture, Forestry, and Fisheries, Ibaraki (Japan). Remote Sensing Lab.

CHARACTERISTICS OF MOS-1 MESSR IMAGE IN FOREST AREA

HARUO SAWADA, OSAMU NAKAKITA, GENTAKAO, and YOSHIO AWAYA /In NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 155-172 31 Oct. 1990

Avail: CASI HC A03/MF A04

An outline is presented of the evaluation results of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data for forest areas in the Peninsula Malaysia. Four different areas were selected which represented different forest types, such as natural forest, secondary forest, swamp forest and mangrove forest. Some statistical analysis and the clustering analysis were performed on the MOS-1 MESSR images of these forests. By the clustering analysis, six to 11 clusters appeared on each forest area. In each forest class, the ranges of data of both visible and infrared channels were very small (5 to 10 DN in visible and 9 to 21 DN in infrared). The vegetation index ((CH (Channel) 3+CH 4-CH 1-CH 2)/(CH 1+CH 2+CH 3+CH 4)) was found effective for delineating vegetation cover conditions in forest and agricultural land. Author (NASDA)

N92-26056# Institute of Disaster and Earth Sciences, Ibaraki (Japan). Atmospheric and Hydrospheric Science Div.

FLOOD MAPPING ON OCTOBER 17TH 1988 AROUND DHAKA IN BANGLADESH USING MOS-1 MESSR DATA

KAZUROU NAKANE /In NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 173-184 31 Oct. 1990

Avail: CASI HC A03/MF A04

Unprecedented flood inundation occurred in Brahmaputra River and the flood inundated a large area of 1.2 million sq km including the capital city of Dhaka. Fortunately, MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) caught the flooding condition on October 17, 1988, which was received at Bangkok in Thailand. The purpose of this study is application of MOS-1 MESSR data received at Bangkok for flood mapping in foreign countries. For this study, the detailed geographical map and MESSR image taken on October 17, 1988 are prepared, and MESSR image is corrected geometrically for superposing on the geographical map. Then, flooded areas in MESSR image are traced on the geographical map. This flooding map represents approximate ground levels on border lines of inundated areas and the distribution of lowlands and small higher lands in low-lying area. Through the study, it is understood that MOS-1 MESSR data received at Bangkok is useful for flood mapping, if MOS-1 MESSR data could catch flooded area. Author (NASDA)

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VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR IN THE DELINEATION OF HEAVY RAINFALL DISASTER

SHINOBU YAZAKI and SHIGETSUGU UEHARA /In NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 185-206 31 Oct. 1990

Avail: CASI HC A03/MF A04

To verify the effectiveness of MESSR (Multispectral Electronic Self-Scanning Radiometer) data in the field of disaster prevention, the data was applied to the delineation of areas damaged by the heavy rainfall which lasted from the end of June to the beginning of July 1990 in northern Kyushu island. The disaster shows various aspects of ground hazard; landslide, debris flow, inundation of mud flow or inner water inundation. The MESSR data, including the most severely damaged area taken in July shortly after the hazard was available to detect traces of the damages and other MESSR data of the same area taken nearly two years before the hazard, was utilized as a reference. The analysis was carried out in the following way. After registering geometrically and normalizing brightness level between the two images, the difference was calculated to find the change in brightness of each band. As a result, it was found that the change of land surface appears more clearly in bands 2 and 4 and the mode of the change was also found to be discriminable in the feature space of the two bands. Author (NASDA)

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RETRIEVAL OF UPPER PRECIPITABLE WATER PROFILE BASED ON MOS-1/VTIR H2O ABSORPTION CHANNEL DATA

MASAO MATSUMOTO, SHIGEYUKI TAKASAKI, and KIYOSHI TSUCHIYA /In NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 207-222 31 Oct. 1990

Avail: CASI HC A03/MF A04

An attempt is made to retrieve precipitable water profile within the range from top of the atmosphere down to the level of 500 mb based on MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) H2O absorption channel data. The precipitable water profile is retrieved by maximum likelihood solution of linearized radiative transfer equation which represents radiation conservation in the layered atmosphere. Up to 35 percent of root mean square error of the estimation occurred. The difference between observed Brightness Temperature (TB) and calculated TB through LOWTRAN 7 is about 10 K. Computed value is lower than the observed one, the cause of the difference is thought due to the estimation error. For more precise analysis, it is necessary to check overall function of VTIR together with absorption characteristics of radiation by H2O in the spectrum of VTIR H2O absorption channel. Author (NASDA)

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SIMULTANEOUS ESTIMATION OF SEA SURFACE TEMPERATURE AND PRECIPITABLE WATER BASED ON MOS-1/VTIR DATA

SHIGEYUKI TAKASAKI, MASAO MATSUMOTO, and KIYOSHI TSUCHIYA /In NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 223-237 31 Oct. 1990

Avail: CASI HC A03/MF A04

In the retrieval of the precipitable water and the sea surface temperature simultaneously from the data of satellite observation based on the linearized radiative transfer equation, selection of the optimum initial guess values of sea surface temperature, air temperature and precipitable water play an important role. In this study, an attempt is made to select the optimum initial guess values for sub-areas around Japan based on a statistical method, taking into account the atmospheric conditions and the sea surface temperature. Based on these values, precipitable water and sea surface temperature are estimated from MOS-1 (Marine

Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data and compared with sea surface temperature and precipitable water data. The results are in good agreement.

Author (NASDA)

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PROLOGUE OF APPLICATION OF MOS-1 VISIBLE DATA TO FISHING GROUNDS DETECTION: EXAMPLE ON SHIRASU, LARVAE OF SARDINE AND ANCHOVY

DENZO INAGAKE and AKIRA TOMOSADA /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 239-263 31 Oct. 1990

Avail: CASI HC A03/MF A04

Applicability of remote sensing data to fishing ground detection is discussed. The fishing grounds of Shirasu, that is the larvae of sardine and anchovy, are formed in the less saline coastal water and the frontal region between the offshore water and the less saline coastal water. Since the less saline water is the mixture of water from rivers and offshore water, and since Shirasu form schools in the surface layer, water color at the sea surface must contain some data on fishing grounds formation of Shirasu. High gain mode visible band image data of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) acquired on July 21, and August 25, 1989 were compared with the truth data of Shirasu fishing grounds to detect the oceanographic features of the fishing grounds. Several stripe-like structures (slicks) were detected parallel to the coast. Shirasu fishing grounds were distributed in the field of stripe-like structure detected by MOS-1 MESSR. The stripe-like structure was generated by internal wave which propagated inshore and reflected offshore at the coast.

Author (NASDA)

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STUDY OF MOS-1 VTIR DATA FOR VARIABILITY OF THE BRANCH (BE CALLED WARM STREAMER) FROM WARM EDDY AND FOR FISHING GROUND

HIDEO TAMEISHI, OSAMU HONDA, YOSHIHIRO OKADA, TOSHIYUKI KOGUCHI, and KEIICHI IWATA /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 265-292 31 Oct. 1990

Avail: CASI HC A03/MF A04

The relationship between fine structure of warm eddy and fishing ground was investigated using the MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data with assistance of aircraft data. Interesting results obtained are as follow: (1) As MOS-1 VTIR imagery can represent the warm streamer, it is recognized that the spatial accuracy (2.7 km) is enough to appreciate the fine structure; (2) By using the simultaneous aircraft data, it is known that the many schools of sardine are distributed at the head of warm streamer; and (3) It seems that the warm streamer is useful for the transfer of schools toward the north.

Author (NASDA)

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APPLICABILITY OF MOS-1 DATA RECEIVED AT SYOWA STATION TO THE ANALYSIS OF POLAR ATMOSPHERE AND CRYOSPHERE

TRAKASHI YAMANOUCHI, HIROSHI KANZAWA, MAKOTO WADA, FUMIHIKO NISHIO, and SADA O KAWAGUCHI /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 293-324 31 Oct. 1990

Avail: CASI HC A03/MF A04

Applicability of MOS-1 (Marine Observation Satellite-1) sensor data to the analysis of polar atmosphere and cryosphere is examined. Especially, analysis of MSR (Microwave Scanning Radiometer) data for the atmospheric water vapor and liquid water are explained in detail. From February 1989 to January 1990, data of 177 paths were received by the members of the 30th

Japanese Antarctic Research Expedition (JARE) using newly settled multipurpose satellite data receiving system and recorded on HDDT (High Density Digital Tape). Most of those data are from paths between 54 to 70, which covers the region around Syowa Station. Applicabilities of the data to the research subjects are examined with the data of about 10 to 20 scenes of each sensor already processed. Using MSR data of 23.8 and 31.4 GHz, water vapor amount and liquid water content are estimated. For the normal condition, water vapor amount ranged from 0.4 to 1.4 g/sq cm and liquid water content from 0 to 14 mg/sq cm. However, there was a high liquid water content belt around 50 deg S in some paths, corresponding to high brightness temperature of about 190 K. On account of high brightness temperature of ice sheet or sea ice, it is difficult to obtain water vapor amount or liquid water content of atmosphere over those surfaces. Using the VTIR (Visible and Thermal Infrared Radiometer) data of clear area, methods to estimate the sea surface temperature are also examined.

Author (NASDA)

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OBSERVATION OF LINED-UP CUMULUS ROWS UNDER THE WINTER MONSOON SITUATION USING MOS-1 AND RADAR DATA

TOSIO KOIKE (Nagasaki Univ. (Japan).), HIROSHI UEDA (Hokkaido Univ. of Education, Iwamizawa (Japan).), and YASUSHI FUJIIYOSHI (Nagoya Univ., Japan) /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 325-346 31 Oct. 1990

Avail: CASI HC A03/MF A04

Information on the three dimensional shape of clouds and the distributions of water vapor and cloud liquid water contents were derived from MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data. Cloud extent and cloud top temperature were determined using the visible band and two thermal infrared bands respectively. Water vapor and cloud liquid water contents over the sea were retrieved by two microwave bands of MSR and two thermal infrared bands of VTIR. Two scenes of MOS-1 were used. One is around western Hokkaido on December 28, 1988 and another is around Hokuriku on January 25, 1990. Snowfall distributions were observed using the ground based radars. There are usually two modes of cumulus rows under strong winter monsoon: transverse mode and longitudinal mode. Around western Hokkaido, the longitudinal perturbation was a preferred mode. The cloud top temperature rose over the land while cloud area was extended. The radar reflectivity was strong under the high cloud area. Around Hokuriku, snow clouds were the transverse mode. The cloud top temperature was dropped over the land by the orographic effect. The strong reflectivity area appeared the windward side of the cloud. The distributions of water vapor and cloud liquid contents can not be compared with radar reflectivity because of the strong land-radiation effect. This report is presented in viewgraph format.

Author (NASDA)

N92-26064# Ministry of Agriculture, Forestry, and Fisheries, Ibaraki (Japan). Oceanic Fisheries Dept.

RESEARCH PROJECT FOR PRACTICAL USAGE OF MOS-1 DATA COLLECTION SYSTEM

TAKESHI UJIE and AKIRA KUROIWA /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 347-366 31 Oct. 1990

Avail: CASI HC A03/MF A04

For the purpose to improve marine productions, it is quite essential to study and to know the comprehensive oceanographic activities. In fiscal 1986 to 1988, the study and systems evaluation project of MOS-1 (Marine Observation Satellite-1) confirmed possibilities by placing DCP (Data Collection Platform) on board and measuring the water temperature at various depths of the seas. By using MOS-1 DCS (Data Collection System), real time data was collected, recorded, and analyzed for the possible application to fishing services. The project is further transacted to evaluate the performance and practical utilization of the hardwares used in the system from fiscal 1989 to 1991. In 1989, study was

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made not only on the sea water temperature but of the development of various sensors for the oceanographic observations and also for the improvement of compressed data transmission. For the project of fiscal 1990, on the foundation of the result of achievement in fiscal 1989, actual data transmission tests were carried out by using water temperature and salinity sensors. Further experiments are scheduled to improve the method of received data analysis and contrive to make DCP transmitter smaller and lighter.

Author (NASDA)

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MOS-1 DATA APPLICATIONS

VINCENT BERUTI /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 367-377 31 Oct. 1990

Avail: CASI HC A02/MF A04

Presented in viewgraph format, the status of EMDUP (European MOS-1 (Marine Observation Satellite-1) Data Utilization Program) is outlined. Topics addressed include: number of projects by the subjects and sensors; ratio of MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) scenes requested by country; sample of image data from MOS-1 MESSR sensor; and detection of algae in the Adriatic Sea.

Author (NASDA)

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SEA SURFACE TEMPERATURE COMPOSITE IMAGERY USING VTIR AND AVHRR

DANIEL A. DELISLE (INTERA Technologies Ltd., Ottawa (Ontario).) and MARIE-CATHERINE MOUCHOT (Canada Centre for Remote Sensing, Ottawa, Ontario) /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 379-397 31 Oct. 1990

Avail: CASI HC A03/MF A04

Features of oceans are in constant movement and frequent monitoring is crucial, thus real-time data is particularly valuable. Daily measurement is a requirement for factors such as the state and temperature of the sea since measurements quickly lose their value as time passes. One serious problem is cloud cover. Too often, not enough sea area is visible from one satellite observation. However, with the many thermal infrared sensors available now, it is possible to gather SST (Sea Surface Temperature) data from various sources for the same day, but not necessarily at the same time, and generate a composite image. The resulting mosaic could be quite cloud free when SST data are available from complementary data sources. If more than one temperature is found for the same area, the warmer temperature is recorded, assuming that cloud contamination is a cooling phenomenon. To demonstrate this application, SST from MOS-1 (Marine Observation Satellite-1) and NOAA were extracted for the same day and a composite image of the two was generated. Calibrated VTIR (Visible and Thermal Infrared Radiometer) data was obtained by MacDonald Dettwiler Associates (MDA) and raw AVHRR (Advanced Very High Resolution Radiometer) data from the Canadian Atmospheric Environment Service (AES). The study area is the Atlantic Coast of Canada, with MOS-1 covering the northern part of the area, and NOAA the southern portion. In between these areas, the coverage overlapped sufficiently to allow comparison. Although VTIR data has a coarser resolution than NOAA, the two were complementary and once calibrated, easily composited.

Author (NASDA)

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MOS-MESSR IMAGE GEOMETRIC CORRECTIONS

THIERRY TOUTIN (Canada Centre for Remote Sensing, Yellowknife (Northwest Territories).) and YVES CARBONNEAU (Consultants TGIS, Inc., Montreal, Quebec) /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 399-413 31 Oct.

1990

Avail: CASI HC A03/MF A04

The raw MOS (Marine Observation Satellite) MESSR (Multispectral Electronic Self-Scanning Radiometer) image has four bands which have a misregistration of three to four pixels. To avoid multiple resampling to obtain precise geocoded ortho image, a new methodology is described. It enables ortho image generation directly from each band of the raw image. The analysis of the pushbroom scanner and satellite motion geometries and the use of a photogrammetric approach enables the derivation of a vigorous mathematical model for geometric corrections and rectification of the raw MOS-MESSR images. The final accuracy of the geometric corrections is about 1/2 pixel (25 m). Six GCPs (Ground Control Points) are sufficient to achieve this accuracy. Enhancing the GCP acquisition will improve the final accuracy to a 1/3 pixel. A coarse DEM (Digital Elevation Model), with a 70 m accuracy, can be used for the generation of the ortho image, without degrading this accuracy.

Author (NASDA)

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MOS-1 DATA EVALUATION IN THAILAND

CHANCHAI PEANVIJARNPONG /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 415-425 31 Oct. 1990

Avail: CASI HC A02/MF A04

Presented in viewgraph format, MOS-1 (Marine Observation Satellite-1) data evaluation activities in Thailand are outlined. Topics addressed include: outline of MOS-1 data receiving system; ground station; MOS-1 coverage of Bangkok station; MOS-1 coverage in South-East Asia region; receiving condition at the ground stations of Thailand for MOS-1 data; and sample of imagery from MOS-1 data.

Author (NASDA)

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MOS-1 APPLICATION FOR LAND USE MONITORING AND CROPS YIELD ESTIMATION

MANU OMAKUPT /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 427-433 31 Oct. 1990

Avail: CASI HC A02/MF A04

Land Development Department, as an agency among the principle investigators has been participating in MOS-1 (Marine Observation Satellite-1) Verification Program. Research has been carried out by using MESSR (Multispectral Electronic Self-Scanning Radiometer) data of MOS-1 for land use monitoring and to estimate the paddy rice and sugar cane yields. The manual interpretation of MOS-1 images and the automated data analysis by using the MERIDIAN system were used in this study. The results were quite satisfying: high accuracy for land use monitoring and about 75.7 accuracy for rice and sugar cane yields estimation were achieved. MOS-1 data is also used, as much as the available data to map the present land use and the danger from disaster, such as major flooding and typhoon, in conjunction with LANDSAT-TM (Thematic Mapper) and SPOT data in Thailand will allow. However, even though Thailand has ground receiving stations for MOS-1 data reception, the real-time or very recent data are still unable to be gotten because the raw data of MOS-1 at the receiving station have to be sent back to process in Japan. This is one of the limitations that MOS-1 data cannot be promoted to use into an operational scale.

Author (NASDA)

N92-26070# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Remote Sensing in Forestry.

APPLICATION OF MOS-1 DATA TO ASSESS DEFORESTATION IN THAILAND

BOONCHANA KLANKAMSORN /in NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation p 435-446 31 Oct. 1990

Avail: CASI HC A03/MF A04

Forest is an integral part of the ecosystem and its occurrence, structure and growth are intimately linked with the physical

character of the landscape. Management of the forest is actually past and present land use practices. In order to locate and indicate what, where and how much of the forest resources need to be preserved and managed, remote sensing has been used as a tool for surveying and mapping to assess forest resources in Thailand. The satellite data not only LANDSAT, SPOT but also MOS-1 (Marine Observation Satellite-1) data from NASDA (National Space Development Agency of Japan) were used for this purpose. The visual interpretation and image analysis were conducted. MOS-1 data were verified for evaluation of deforestation in crisis area. The results revealed that MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) data can be used for detection of existing forest and non-existing forest areas in Thailand. Moreover, mangrove forest areas can be classified from other forest types. In some areas, if evergreen and dry dipterocarp forest types occur is widely spaced, they can be classified by using the help of bioclimatic and physiographic factors.

Author (NASDA)

N92-26071# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Soil Science Div.

THE APPLICATIONS OF MOS-1 DATA TO STUDY THE DAMAGES CAUSED BY TYPHOON IN RUBBER PLANTATION OF CHUMPHON PROVINCE, THAILAND

PONGPIT PIYAPONGSE, EKANIT HANSAKDI, and ANOP KICHTHAM *In NASDA, International Conference on Japanese Earth Observation Programs: Symposium on MOS-1 Data Evaluation* p 447-457 31 Oct. 1990

Avail: CASI HC A02/MF A04

Natural disaster caused by typhoons results in severe damage in agricultural areas and causes more and more problems in Thailand. The use of satellite based data to study the damages is a very useful tool for the government to send rescuers to these areas. MOS-1 (Marine Observation Satellite-1) from VTIR (Visible and Thermal Infrared Radiometer) sensors were used together with NOAA and SPOT data to study the movement and damage of typhoon 'Guy' which struck Chumphon province on November 4, 1989. The MOS-1 VTIR and MESSR (Multispectral Electronic Self-Scanning Radiometer) data were analyzed. Personal computers using MICRO-ASEAN software, NOAA-11 (infrared), SPOT and topographic maps of the study area were used in combination with ground information data collection. The results obtained are summarized to come to the following conclusions: (1) MOS-1 VTIR can be used effectively to study the formation of typhoon (tropical storm) and depressions together with other meteorological satellite data; (2) MOS-1 MESSR, when used during rainy season in tropical zones, can sense cloud covered problems; and (3) The result obtained indicated that about 130,000 rais of rubber plant, 138,202 rais of coconut, 89,126 rais of oil palm and 28,734 rais of rice plant in the study area were completely destroyed by the typhoon. In the future the combinations of data from various satellites will be a very useful tool to study the distribution and occurrence, processes and causes, the impacts, mitigation, and reduction of natural disasters on a global basis. Author (NASDA)

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INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: TRMM WORKSHOP

1 Nov. 1990 198 p Conference held in Ibaraki, Japan, 1 Nov. 1990

(JTN-92-80345) Avail: CASI HC A09/MF A03

The following topics were discussed: outline of TRMM (Tropical Rainfall Measuring Mission), TRMM mission, mission team of TRMM Project, application of TRMM data, rain radar, active array radar, rainfall retrieval algorithms, precipitation observation, rainfall pattern observation, research plan, numerical model of precipitation, and hydrological cycle. All of the report is presented in viewgraph format.

Author (NASDA)

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THE TROPICAL RAINFALL MEASURING MISSION (TRMM) PROGRAM AT THE GODDARD SPACE FLIGHT CENTER (GSFC)

JOHN HRASTAR *In NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop* p 1-14 1 Nov. 1990

(TW-1) Avail: CASI HC A03/MF A03

Presented in viewgraph format, the status of Tropical Rainfall Measuring Mission (TRMM) Project at NASA Goddard Space Flight Center (GSFC) are outlined. Topics addressed include: TRMM Project organization; TRMM Project/Science interfaces; U.S./Japan responsibilities; TRMM spacecraft summary; TRMM instruments; implementation plan; status of activities; and schedule of project.

Author (NASDA)

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STATUS OF TRMM PROJECT: RAIN RADAR IN THE TROPICAL RAINFALL MEASURING MISSION

KENICHI OKAMOTE *In NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop* p 15-35 1 Nov. 1990

(TW-2) Avail: CASI HC A03/MF A03

Presented in viewgraph format, the rain radar development for TRMM (Tropical Rainfall Measuring Mission) satellite conducted by Communications Research Laboratory (CRL) are outlined. Topics addressed include: schedule of TRMM Project; U.S./Japan responsibilities for project; mission requirement of radar; outline of active array radar RF (Radio Frequency) section; main system parameters of TRMM rain radar; status of TRMM rain radar development; radiation pattern of array antenna; and performance of manufactured phase shifter, high power amplifier, and low noise amplifier.

Author (NASDA)

N92-26704# National Space Development Agency, Tokyo (Japan). Earth Observation Program Office.

STATUS OF TRMM (NASDA)

SHIZUO YAMAMOTO *In its International Conference on Japanese Earth Observation Programs: TRMM Workshop* p 37-51 1 Nov. 1990

(TW-3) Avail: CASI HC A03/MF A03

Presented in viewgraph format, status of Tropical Rainfall Measuring Mission (TRMM) Project in National Space Development Agency of Japan (NASDA) are outlined. Topics addressed include: NASDA's role and organization related to TRMM Project; cooperation and responsibility with other organizations; altitude profile of TRMM orbit; mission analysis; status of H-2 launch vehicle, new launch site, and launching schedule; technical interface between H-2 launch vehicle and TRMM, and TRMM S/C (Spacecraft) and rain radar; new phase budget proposal; and schedule of TRMM Project in NASDA.

Author (NASDA)

N92-26705# National Space Development Agency, Tokyo (Japan). Earth Observation Program Office.

TRMM MISSION TEAM

SHIZUO YAMAMOTO *In its International Conference on Japanese Earth Observation Programs: TRMM Workshop* p 53-61 1 Nov. 1990

(TW-4) Avail: CASI HC A02/MF A03

Presented in viewgraph format, activity of Tropical Rainfall Measuring Mission (TRMM) Mission Team supported by the National Space Development Agency (NASDA) of Japan are outlined. Topics addressed include: background of TRMM Mission Team; members of the team; objectives of the team; and present and future activities.

Author (NASDA)

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TROPICAL RAINFALL MEASURING MISSION (TRMM) SCIENCE REPORT

EASTWOOD IM and JOHN THEON *In NASDA, International*

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Conference on Japanese Earth Observation Programs: TRMM Workshop p 63-73 1 Nov. 1990
(TW-5) Avail: CASI HC A02/MF A03

Presented in viewgraph format, a review of scientific researches utilizing the Tropical Rainfall Measuring Mission (TRMM) satellite data are described. Topics addressed include: global precipitation; TRMM orbit; satellite calibration; international cooperation; outline of TRMM research progress; status of TRMM science NRA; and the progress of the project for the last ten years and view of the project for the next ten years. Author (NASDA)

N92-26707# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

STORM MODEL AND BEAM FILLING PROBLEM FOR RAIN RETRIEVALS

KENJI NAKAMURA /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 75-88 1 Nov. 1990

(TW-6) Avail: CASI HC A03/MF A03

Presented in viewgraph format, investigation of the beam filling problem using a model of rain statistics and/or real data are described. Topics addressed include: bias error; relationship between brightness temperature and rainfall rate; beam footprint of rain radar; field of view; rain cell model; convective rain; and Tropical Rainfall Measuring Mission (TRMM) satellite rain radar. Author (NASDA)

N92-26708# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

DEVELOPMENT OF TRMM RADAR RAINFALL RETRIEVAL ALGORITHMS

TOSHIKI KOZU /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 89-106 1 Nov. 1990

(TW-7) Avail: CASI HC A03/MF A03

Presented in viewgraph format, status of rainfall retrieval algorithms development for the Tropical Rainfall Measuring Mission (TRMM) rain radar are described. Topics addressed include: importance of radar measurement; requirements for TRMM rain radar resolution; processing flow of the radar data; rainfall parameters to be estimated such as rain rate, liquid water content (LWC), storm height, storm type, Z-R relation, and raindrop size distribution (RSD); merits and demerits of estimation method such as Z-R Method, Surface Reference (SRT) Method, Range Profiling Methods; outline of aircraft rainfall observation experiment conducted by NASA and the Communications Research Laboratory (CRL) of Japan; and issues, procedures, and plans for TRMM radar algorithm development. Author (NASDA)

N92-26709# Tokyo Univ. (Japan).

VALIDATION OF NUMERICAL MODELS BY TRMM AND VALIDATION OF TRMM BY NUMERICAL MODELS

AKIYOSHI SUMI /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 107-132 1 Nov. 1990

(TW-8) Avail: CASI HC A03/MF A03

Presented in viewgraph format, a method for validating Tropical Rainfall Measuring Mission (TRMM) radar data and for estimating performance of hydrological circulation model are described. Topics addressed include: comparison between observed data and calculated data of precipitation amount; buoy utilization; water circulation model; estimated precipitation and evaporation amount; and measurements of air temperature, Intraseasonal Variation (IVS); surface wind fields and Sea Surface Temperature (SST). Author (NASDA)

N92-26710# Nagoya Univ. (Japan). Water Research Inst.
WATER CYCLES AROUND THE SUBTROPICAL FRONTAL ZONE IN EAST ASIA

KURANOSHIN KATO and TAKAO TAKEDA /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 133-152 1 Nov. 1990
(TW-9) Avail: CASI HC A03/MF A03

Presented in viewgraph format, observations of subtropical frontal zone rainfall amount, meso-scale cloud cluster climatology, and relationships between the structure of subtropical high and rainfall amount in its surrounding areas using Tropical Rainfall Measuring Mission (TRMM) satellite data are explained. Topics addressed include: objectives of TRMM observation; distribution of precipitation amount; location of rain front in east Asia region; and subtropical high. Author (NASDA)

N92-26711# Nagoya Univ. (Japan).

RAINFALL PATTERN OVER THE TROPICAL RAIN FOREST

HIROSHI TANAKA /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 153-166 1 Nov. 1990

(TW-10) Avail: CASI HC A03/MF A03

Presented in viewgraph format, reviews of water cycle associated with tropical rain forest are given. Topics addressed include: water cycle model over the tropical rain forest; Rutter Model; Manta Model; Global Climate Model (GCM); relation of rainfall to throughfall; comparison of calculated water on canopy with observed rainfall data; calculated throughfall and evaporation; accumulated difference between observed and calculated throughfall; simulated runoff losses; comparison of observed and predicted interception loss; and simulated monthly variation of precipitation. Author (NASDA)

N92-26712# Japan Meteorological Agency, Tokyo. Meteorological Coll.

UTILIZATION OF TROPICAL CONVECTION DATA FOR METEOROLOGICAL OPERATION

TSUYOSHI NITTA /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 167-177 1 Nov. 1990 In ENGLISH and JAPANESE

(TW-11) Avail: CASI HC A02/MF A03

Presented in viewgraph format, application of the Tropical Rainfall Measuring Mission (TRMM) tropical convection monitoring data to long-range forecasts are discussed. Topics addressed include: numerical forecast model; typhoon forecast; Intraseasonal Variation (ISV) of convection; Intraannual Variation (IAV) of convection; and relations of sea surface temperature around the tropical region and atmospheric temperature. Author (NASDA)

N92-26713# Meteorological Research Inst., Tsukuba (Japan).

TRMM AND ASIAN MONSOON

MASATO MURAKAMI /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 179-189 1 Nov. 1990

(TW-12) Avail: CASI HC A02/MF A03

Presented in viewgraph format, application of Tropical Rainfall Measuring Mission (TRMM) data to the Asian monsoon investigation are explained. Topics addressed include: TRMM orbits; TRMM coverage area; precipitation in monsoon Asia; Intraseasonal Variation (ISV) of convection; rainfall intensity on small and large islands; and distribution of the Western Pacific upperair station. Author (NASDA)

N92-26714# Meteorological Research Inst., Tsukuba (Japan).

RESEARCH PLAN FOR UTILIZING TRMM DATA IN MRI

TETSUO NAKAZAWA /n NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 191-204 1 Nov. 1990

(TW-13) Avail: CASI HC A03/MF A03

Presented in viewgraph format, progress and plans of meteorological researches such as estimation of rainfall and sea surface conditions, analysis of rain-producing disturbances over the tropics, climate, modeling study utilizing Tropical Rainfall Measuring Mission (TRMM) data in Meteorological Research Institute (MRI) are outlined. Topics addressed include: Split Window Technique; cloud type classification; total column water vapor; sea surface wind speed; wide-range variations of tropical convections; Intraseasonal Variation (ISV); super cluster; cloud cluster; cumulus; interactions with multi-scale convective systems; importance of latent heat release; three dimensional heating profile; model climate

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by long term integration; cumulus parameterization; total precipitation; and air-sea interaction process by air-sea coupled model.
Author (NASDA)

N92-26715# Institute of Disaster and Earth Sciences, Ibaraki (Japan).

RESEARCH PROGRAM ON HYDROLOGY

TAKEO KINOSHITA *In* NASDA, International Conference on Japanese Earth Observation Programs: TRMM Workshop p 205-210 1 Nov. 1990 In ENGLISH and JAPANESE (TW-14) Avail: CASI HC A01/MF A03

Presented in viewgraph format, application of Tropical Rainfall Measuring Mission (TRMM) rainfall data to hydrological cycle investigation are discussed. Topics addressed include: hydrological cycle; hydrological forecasting; flood; drought; snow hazard; natural disaster reduction; atmospheric moisture; surface water; ground water; and runoff model.
Author (NASDA)

N92-26742# National Space Development Agency, Tokyo (Japan).

INTERNATIONAL CONFERENCE ON JAPANESE EARTH OBSERVATION PROGRAMS: PLENARY SESSION

29 Oct. 1990 110 p Conference held in Ibaraki, Japan, 29 Oct. 1990

(JTN-92-80342) Avail: CASI HC A06/MF A02

Current status and future plans about earth observation programs of NASA, ESA, NASDA (National Space Development Agency of Japan), CNES (Centre National d'Etudes Spatiales), CCRS (Canadian Centre for Remote Sensing), and NRCT (National Research Council of Thailand) were outlined. Topics addressed include: earth observation satellites, remote sensing, satellite sounding, remote sensors, ground stations, data systems, data distribution, and land management. All of the reports are presented in viewgraph format.

Author (NASDA)

N92-26743# National Space Development Agency, Tokyo (Japan).

JAPANESE EARTH OBSERVATION PROGRAM

YUKIO HARUYAMA *In its* International Conference on Japanese Earth Observation Programs: Plenary Session p 1-30 29 Oct. 1990

Avail: CASI HC A03/MF A02

Presented in viewgraph format, NASDA's (National Space Development Agency of Japan) earth observation program was outlined. Objectives, current status, characteristics, and operation schedules of Japanese satellites such as GMS (Geostationary Meteorological Satellite), MOS-1 (Marine Observation Satellite-1), MOS-1b, JERS-1 (Japan Earth Resources Satellite-1), ADEOS (Advanced Earth Observing Satellite), TRMM (Tropical Rainfall Measuring Mission) satellite, and JPOP (Japanese Polar Orbiting Platform) were presented.
Author (NASDA)

N92-26745# European Space Agency, Paris (France).

EUROPEAN EARTH OBSERVATION PROGRAM

V. BERUTI *In* NASDA, International Conference on Japanese Earth Observation Programs: Plenary Session p 39-64 29 Oct. 1990

Avail: CASI HC A03/MF A02

Presented in viewgraph format, objectives, missions, and current status of ESA's earth observation program and EARTHNET activities were outlined. Topics addressed include: EARTHNET network; environmental monitoring; ERS-1 satellite; ERS-2 satellite; ARISTOTELES satellite; COLUMBUS polar platform; METEOSAT satellite; POEM-1 (First Polar Orbit Earth Observation Mission); MOP-2 (METEOSAT Operational Program-2) satellite; MOP-3 satellite; ocean observation; ice observation; land observation; meteorological survey; solid earth mission; POEM (Polar Orbit Earth Observation Mission); and ground stations.
Author (NASDA)

N92-26749# National Research Council, Bangkok (Thailand).

MOS-1 ACTIVITY REPORT

P. CHANCHAI *In* NASDA, International Conference on Japanese

Earth Observation Programs: Plenary Session p 99-111 29 Oct. 1990

Avail: CASI HC A03/MF A02

Presented in viewgraph format, current status of Thailand earth observation program was outlined. Topics addressed include: activity of National Research Council of Thailand (NRCT); policy and plans of National Remote Sensing Coordinating Committee; ground stations; data systems; data reception from MOS-1 (Marine Observation Satellite-1), SPOT, LANDSAT and ERS-1; and outlines of ongoing joint research projects.
Author (NASDA)

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ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

A92-21144

APPLICATION OF A SODIUM SULFUR CELL WITH DYNAMIC SULFUR ELECTRODE TO A BATTERY SYSTEM

H. TOKOI, K. TAKAHASHI, and S. SHIMOYASHIKI (Hitachi, Ltd., Energy Research Laboratory, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, Jan. 1992, p. 10-15. refs
Copyright

The construction and performance of a sodium sulfur battery system with dynamic sulfur electrodes are described. Three cells were first connected in parallel, then two such groups were connected in series. Each cell included a liquid sodium-filled beta-double-prime-alumina tube and a system to feed liquid sulfur into the annular cathode. Low-resistance graphite felt was tightly packed around the beta-double-prime-alumina tube. Sodium pentasulfide was removed from the sulfur electrode. The battery was operated automatically and stably charged and discharged in the two-phase region. The discharged energy was 4372 Wh (capacity 1170 Ah) during a continuous operation of 19.5 h. The discharge/charge energy efficiency of the battery was 82 percent at an averaged current density of 100 mA/sq cm and operating temperature of 350 C. The deviation of the cell current in a parallel chain was less than 7 percent, and this was induced by the difference in internal resistance. In the daily charge/discharge cycle, cell capacity with the dynamic sulfur electrode was 1.5 times higher than that with the static sulfur electrode using the same active surface of beta-double-prime-alumina, because the internal resistance of the former cell was constant regardless of cell capacity. This battery system with a dynamic sulfur electrode can be applied to energy storage systems, such as large scale load leveling systems, electric vehicle batteries, and solar energy systems.
Author

A92-26507

EFFECT OF WATER VAPOR ON THE GROWTH OF TEXTURED ZNO-BASED FILMS FOR SOLAR CELLS BY DC-MAGNETRON SPUTTERING

TOKIO NAKADA, YUKINOBU OHKUBO, and AKIO KUNIOKA (Aoyama Gakuin University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3344-3348. refs

Copyright

Large-grain zinc oxide (ZnO) films were deposited on glass substrates by DC magnetron sputtering in H₂O-Ar mixtures at elevated substrate temperatures. The 002-plane-oriented columnar structure grown in pure Ar changed into the granular structure as the partial pressure of water vapor increased. Low-resistivity pyramidal textured ZnO:Al films were sputter-deposited in a mixture of H₂O-Ar(1:1) at 300-400 C. The 2-micron thick films possessed a sheet resistance of 9 Ohms/sq unit and an optical transmission of 80 percent at 550 nm after annealing in a vacuum. These films have considerable potential as window materials for solar cells.
Author

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A92-27650

**INTERNATIONAL PHOTOVOLTAIC SCIENCE AND
ENGINEERING CONFERENCE, 5TH, KYOTO, JAPAN, NOV.
26-30, 1990, TECHNICAL DIGEST**

Conference sponsored by Japan Society of Applied Physics, Institute of Electrical Engineers of Japan, Agency of Industrial Science and Technology, et al. Kyoto, Japan, International PVSEC-5, 1990, 1072 p. No individual items are abstracted in this volume.

The present conference on photovoltaic science and engineering encompasses amorphous silicon materials, compound solar cells, a national photovoltaic project, solar cells fabricated from polycrystalline silicon and amorphous silicon, the use of solar cells in space systems, photovoltaic systems components, and experience from field use of the systems. Specific issues addressed include the status of the U.S. National Photovoltaic Program, a novel p-type window material for amorphous silicon solar cells, low dislocation-density GaAs on Si for solar cells, the spin-cast process for Si solar cells, advances in a-Si:H alloy multijunction devices, and n-ZnO/p-MoSe₂ heterojunction solar cells. Also addressed are polycrystalline photovoltaic silicon-ingot production, cells with large areas and high efficiency, a vacuum-evaporated CdS/CdTe solar cell, proton-irradiation damage in thin-film GaAs solar cells fabricated on Si substrates, and advanced power systems for the Space Station Freedom. C.C.S.

A92-29509

A NEW TYPE OF ULTRALIGHT FLEXIBLE A-SI SOLAR CELL
YASUO KISHI, HIROSHI INOUE, KENJI MURATA, SHINICHI
KOUZUMA, MASASHI MORIZANE, HISASHI SHIBUYA, HIDENORI
NISHIWAKI, and YUKINORI KUWANO (Sanyo Electric Co., Ltd.,
Functional Materials Research Center, Hirakata, Japan) Japanese
Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, Jan.
1992, p. 12-17. refs
Copyright

An ultralight flexible a-Si solar cell fabricated on a transparent polyimide film substrate is developed. High photoconductivity of $2 \times 10 \exp -5/\text{ohm/cm}$ and high photosensitivity $1 \times 10 \exp 6$ were obtained with a-Si films deposited by H₂-dilution of SiH₄ on a transparent polyimide film substrate at 180 C. Prebaking the transparent polyimide film substrate effectively reduced the impurity content of the a-Si film. A maximum output power of 550 mW and a power-to-weight ratio of 275 mW/g were obtained for an integrated-type a-Si solar cell with a size of 110 x 115 mm.

Author

A92-29520

**THE EFFECTS OF THE SOLAR POWER SATELLITE AND THE
MOON RESOURCE DEVELOPMENTS ON THE EARTH'S
ECOLOGICAL AND ECONOMICS SYSTEM**

YOSHIKI YAMAGIWA, NORIHISA KANEDA, KOUSUKE SUZUKI,
YOSHIO ISHIKAWA, and KYOICHI KURIKI Japan Society for
Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol.
40, no. 457, 1992, p. 111-118. In Japanese. refs

A system dynamics simulation model is proposed for evaluating the effects of developments of the Solar Power Satellite (SPS) and the moon resource (He-3) on the earth's ecological and economics systems. The relation between parameters in the model and simulation results is analyzed and the effective range of conditions in the developments of SPS and the moon resource is roughly estimated.

Author

A92-34143

**RELATION BETWEEN THE CONDITIONS OF PREPARATION
AND THE POLARIZATION CHARACTERISTICS OF SPONGY
RANEY NICKEL ELECTRODES USED AS ANODES FOR FUEL
CELLS**

TAHEI TOMIDA, KAZUHIRO OKAMURA, TOSHIFUMI ASHIDA, and
ICHIRO NAKABAYASHI (Tokushima, University, Japan)
Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, April
1992, p. 981-984. refs
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Spongy Raney nickel electrodes were prepared from substrates

of spongy nickel plate coated with aluminum. Influences of the temperature for alloying and the weight ratio of aluminum to nickel (Al/Ni) in the substrate on polarization characteristics were studied in connection with the alloy compositions formed, and the surface microstructure of the catalysts. For this, the ratio Al/Ni in the substrate was varied ranging from 0.1 to 2.5. Electrode performance was improved, with increases in both the temperature for alloying and the Al/Ni ratio of the substrates. However, the higher the temperature used for alloying, the lower were the effects of the Al/Ni ratio. The activated Raney nickel was prepared from an alloy whose components were NiAl₃ and/or Ni₂Al₃. It was also shown that a good polarization performance resulted from the increase in activated nickel grains, which were observed by scanning electron microscopy, and an increase in the Brunauer, Emmett, and Teller (BET) surface area of the electrode-catalyst. The broad peaks observed in X-ray diffraction of Raney nickel catalysts implied crystal distortions, which should be closely related to an increase in the BET surface area.

Author

A92-37819

**HIGH PERFORMANCE BATTERY AND ITS COMPUTER
SIMULATION TECHNOLOGY**

KIYONAMI TAKANO, KATSUHIKO KANARI, KEN NOZAKI,
TOSHIHISA MASUDA, KAZUO ONDA, and MASAYUKI
KAMIMOTO Electrotechnical Laboratory, Circulars (ISSN
0366-9084), no. 222, Aug. 1991, 117 p. In Japanese. refs

The current status of advanced high-performance batteries and their simulation technology is reviewed in a systematic manner. In particular, attention is given to the energy, power density, efficiency, life, and capacity requirements; battery evaluations; and computer simulation studies. Results of evaluation studies are reported for some typical batteries, and it is suggested that the lithium secondary battery is particularly promising for high-density power systems. Results of simulations are presented for different types of batteries, including lead-acid, sodium-sulfur, lithium-iron sulfate, lithium, and zinc-bromine cells. Various battery applications are discussed, including electric vehicle propulsion.

V.L.

A92-40446

**AN EVOLUTIONARY SATELLITE POWER SYSTEM FOR
INTERNATIONAL DEMONSTRATION IN DEVELOPING
NATIONS**

N. NAGATOMO (Institute of Space and Astronautical Science,
Sagamihara, Japan) and KIYOHICO ITOH (Hokkaido University,
Sapporo, Japan) IN: SPS 91 - Power from space; Proceedings
of the 2nd International Symposium, Gif-sur-Yvette, France, Aug.
27-30, 1991. Paris, Societe des Electriciens et des Electroniciens
and Societe des Ingenieurs et Scientifiques de France, 1991, p.
356-363. refs

The ISAS solar power satellite working group is working on a concept of an SPS strawman model for demonstration of electric power supply to customers at the earliest opportunity. The SPS is modularized, so that each unit can be launched by a commercial launcher to an equatorial low earth orbit where it is assembled automatically. The satellite can supply electric power by microwave to rectennas at every pass. Based on this model, technological and programmatic characteristics of a small SPS are discussed.

Author

A92-40471

**AN INLAND RECTENNA USING REFLECTOR AND CIRCULAR
MICROSTRIP ANTENNAS**

KIYOHICO ITOH and Y. OGAWA (Hokkaido University, Sapporo,
Japan) IN: SPS 91 - Power from space; Proceedings of the 2nd
International Symposium, Gif-sur-Yvette, France, Aug. 27-30, 1991.
Paris, Societe des Electriciens et des Electroniciens and Societe
des Ingenieurs et Scientifiques de France, 1991, p. 535-540.
refs

A rectenna must have high efficiency of 2.45 GHz microwave to dc conversion, and must suppress reradiation of higher harmonic microwave generated by rectifying diodes. A circular microstrip antenna (CMSA) has an important characteristic to reduce the reradiation of higher harmonic microwave. This paper presents an

inland rectenna using reflector and CMSAs. The CMSAs are used for a primary radiator (receiving area) of the reflector antenna. The reradiation is reduced by the CMSAs. If the primary radiator is placed at an optimum position, the maximum conversion efficiency of the rectifying diodes may be obtained. Several equations which can be used for the optimum design are derived. Moreover, because the reflector is composed of wires, the rectenna passes the sunshine. Thus, the SPS system does not affect the environment and human society. Author

A92-47800

NUMERICAL ANALYSIS OF CHARGE AND DISCHARGE CHARACTERISTICS OF ADVANCED ENERGY STORAGE SYSTEMS

KATSUHIKO KANARI Electrotechnical Laboratory, Researches (ISSN 0366-9106), no. 936, Jan. 1992, 123 p. In Japanese. refs

A thermal energy storage system using phase-change materials and flow batteries was investigated, and computer simulation models were developed for estimating charge and discharge characteristics of latent thermal energy storage units using high-density polyethylene, pentaerithritol, and molten salts. These models are useful for evaluating the charge and discharge characteristics of the energy storage system, conducting feasibility studies for new applications, and for optimizing thermal-energy storage units. Computer simulation models were also developed for the analysis of shunt current flowing in redox flow and Zn/Br batteries. These models can be used for estimating the round-trip efficiencies, the state of charge, the terminal voltage, and, in case of Zn/Br battery, for the distribution of zinc metal deposited in the cells in a stack. I.S.

A92-50740

SOME APPROACHES TO IMPROVE THE LIFE PERFORMANCE OF PHOSPHORIC ACID FUEL CELL

MAKOTO AOKI, YUKO UEKI, HIROHUMI ENOMOTO (Fuji Electric Corporate Research and Development, Ltd., Yokosuka, Japan), and KOUICHI HARASHIMA (Fuji Electric Corporate Research and Development, Ltd., Ichihara, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 3. La Grange Park, IL, American Nuclear Society, 1991, p. 572-576. refs Copyright

Two approaches were used to improve cell life performance while keeping power density high. In one, the wettability of the cathode and anode was optimized, and in the other, a heat treatment was applied to the carbon support for the cathode catalyst. As a result, it was discovered that the wettability of the cathode should be decreased and that of the anode should be increased in order to prevent cell performance from decreasing due to the migration of phosphoric acid. Heat treatment of the carbon support at high temperatures very effectively decreased the wettability of the cathode and also decreased the rate of catalytic activity loss, that is, improved cell life performance. I.E.

A92-50808

ELECTRODE MATERIALS FOR ALKALI METAL THERMOELECTRIC CONVERTER (AMTEC)

O. ASAKAMI, K. SHIBATA, T. HASHIMOTO, H. NAKATA, K. TSUCHIDA, and A. KATO (Kyushu University, Fukuoka, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 5. La Grange Park, IL, American Nuclear Society, 1991, p. 469-474. Research supported by MOESC. refs Copyright

Porous electrodes of TiN, NbN, TiC and Mo were prepared by screen printing method and their Alkali Metal Thermoelectric Converter (AMTEC) performances were examined. To find optimum preparation condition, the film was prepared on flat alpha-alumina or beta double prime-alumina substrate in preliminary examinations. A paste made from metal, nitride or carbide powder and organic vehicle was printed on the substrate by using 200 mesh screen and heat-treated in NH₃-H₂ or Ar-H₂ atmosphere. In the preparation of TiN and NbN films, the use of pre-nitridized Ti or Nb

powder was effective to decrease the cracks and then the resistivity of the final film. By using the same method, porous electrode was prepared on beta double prime-alumina tube. AMTEC properties with the screen printed electrode were measured at a sodium temperature of 600-800 C. The maximum power densities of TiN, NbN, Mo, and TiC electrodes are given. The ac impedance analysis showed that the impedance was dependent on the current density of AMTEC. This current-dependent component is considered to be due to the polarization at the interface between the electrode and beta double prime-alumina and resistance for dispersion of Na through the porous electrode. I.E.

A92-52951

IMPROVEMENT OF LITHIUM-CONTAINING MANGANESE DIOXIDE (COMPOSITE DIMENSIONAL MANGANESE OXIDE: CDMO) AS POSITIVE MATERIAL FOR LITHIUM SECONDARY BATTERIES

T. NOHMA, Y. YAMAMOTO, I. NAKANE, and N. FURUKAWA (Sanyo Electric Co., Ltd., Functional Materials Research Center, Hirakata, Japan) Journal of Power Sources (ISSN 0378-7753), vol. 39, no. 1, June 1992, p. 51-57. refs Copyright

The paper describes the development of an improved lithium-containing manganese dioxide (composite dimensional manganese oxide, CDMO) as a positive material for lithium secondary batteries with high discharge voltage and capacity. It was found that CDMO charged to a high potential (i.e., 3.6 V compared with normal charge 3.3 V) exhibited a higher discharge voltage and a greater capacity. The optimum conditions for preparing improved CDMO include heat treatment (at about 250 C) of LiOH and electrolytic manganese dioxide at a Li/Li + Mn atomic ratio of 0.3. The improved CDMO exhibits a discharge capacity of over 200 A h/g, and excellent rechargeability. I.S.

A92-55869

ISY-METS ROCKET EXPERIMENT AND ITS PREPARATORY AIRPLANE EXPERIMENT

H. MATSUMOTO (Kyoto University, Uji, Japan) and N. KAYA (Kobe University, Japan) et al. IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 5 p. refs (IAF PAPER 92-0576) Copyright

It is very important and indispensable for power supplying in space as well as to the ground to develop technologies of the microwave energy transmission. We are planning a rocket experiment (METS: Microwave Energy Transmission in Space) and its preparatory airplane experiment called MILAX (Microwave Lifted Aircraft Experiment) in the International Space Year. The METS aims to verify a newly developed microwave energy transmission system for space use and to study nonlinear effects of the microwave energy beam in the space plasma environment. We will also perform a ground-based energy transmission test of the developed system by using a small airplane as a target before the launch. In this paper, we describe the newly developed active phased-array antenna in detail. Author

N92-13481# Central Research Inst. of Electric Power Industry, Chiba (Japan).

DEVELOPMENT OF CATALYST FOR FUEL CELLS BY MIMICKING BIO-MATERIALS

HIROSHI SAIKI Jul. 1989 22 p In JAPANESE; ENGLISH summary (DE90-503394; CRIE-U-89001) Avail: CASI (US Sales Only) HC A03

The development of fuel cells has been one of technological innovations in energy conversion field. The fuel cells using phosphoric acid as electrolyte need platinum which is rare metal and expensive; therefore, an alternative catalyst instead of platinum has been sought. On the other hand, the respiratory reactions in a mammal include a reduction in which molecular oxygen is converted into water; this reaction is very similar to the role of an oxygen electrode of fuel cells. A porphyrin derivative which has a similar structure to cytochrome C, which is respiratory enzyme, was synthesized to study possibility of application in the catalyst

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of the oxygen electrode reaction. A glassy carbon electrode was prepared by coating with a layer of the porphyrin derivative. Catalytic activities in the reduction of molecular oxygen, which is supplied from air, were examined using the porphyrin derivative. The carbon electrode covered with the porphyrin catalyzed the reduction of molecular oxygen to water. These results suggest that this porphyrin can act as catalyst of fuel cells. DOE

N92-15423# New Energy Development Organization, Tokyo (Japan).

SURVEY CONCERNING HYDROGEN SUPPLYING SYSTEM FOR PHOSPHORIC ACID FUEL CELLS, PART 2

Mar. 1989 99 p In JAPANESE; ENGLISH summary (DE90-503593; NEDO-P-8810-PT-2) Avail: CASI (US Sales Only) HC A05/MF A02

Most phosphoric acid fuel cells have excellent features on load variation and lower load characteristics. In order to exhibit these features further, it is necessary to reasonably improve the hydrogen supplying system and a powerful measure is to apply the thermally effective conversion technology (TECT) using a permeable solid to a reformer. Subsequent to the fundamental survey carried out in 1988, the conceptual design of the reformer applying this idea was carried out this year to make static and dynamic analyses and address problems which occur in practical use. Dynamic simulation for the reformer applying TECT showed excellent loading response and agreed well with the previous fundamental experiments. In addition, the conceptual design of a fuel cell power generating system by using this TECT applied reformer was made and a comparatively compact unit became possible. DOE

N92-19640# Japanese Society of Energy Resources, Osaka. **PROCEEDINGS OF THE 10TH STUDY PRESENTATION MEETING OF JAPAN SOCIETY OF ENERGY AND RESOURCES**

1991 314 p Meeting held in Tokyo, Japan, 24-25 Apr. 1991 (DE92-729087; CONF-9104313) Avail: CASI HC A14/MF A03

Concerning solar/natural energy, reports are made on a design of wind turbine arrays, hydrogen production by solar thermal conversion, demonstration tests with the interconnected system, etc. About the combustion, discussions are made on efficiency and pollution abatement measures. Besides solid electrolyte and internal-heat-reforming type molten carbonate fuel cells, test runs of phosphoric acid fuel cells for the district heat supply/on-site use are conducted. Furthermore, studies on the ocean thermal energy conversion and the wave power generation are taken up. The global energy system is also proposed which combines the photovoltaic power generation, hydrogen production and methanol fuel synthesis using flue gas CO₂ transported by tanker in the desert for the global warming prevention/resource recycling. Reports on energy conservation using energy storage and heat pumps are made. Application of electric power to superconductivity technology is reported on. As for the energy system, district cooling and heating, alternative energy, cogeneration, etc. are introduced, and then many examples of energy conservation and non-pollution are presented. DOE

N92-20924# Tokyo Univ., Sagami-hara (Japan).

BRAYTON-RANKINE TOTAL ENERGY SPACE DYNAMIC POWER SYSTEM ANALYSIS

ZHI-GUANG LING and KOICHI OSHIMA In its Proceedings of the Symposium on Mechanics for Space Flight 1990 p 69-80 Mar. 1991

Avail: CASI HC A03/MF A02

A study was made on combined Brayton-Rankine total energy space dynamic power system. Thermodynamic analysis and comparative calculation were performed for the system and the regenerative Brayton system. Results show that under space conditions even with water as the working fluid of the Rankine part, the thermal efficiency could be raised by 5 to 10 pct. at working point, in comparison with a regenerative Brayton system and with the existing technology for the Rankine system alone. An increase in steam turbine and pumps in comparison with

regenerative Brayton system brought no significant reduction in system weight. Through radiator area analysis, the suggested total energy system shows no significant increase in radiation area. The spray radiator is more suitable for this purpose. Further conceptional projective study is needed to proceed in the optimization of parameters and appropriate working substance together with the spray radiator condenser design considerations. Author

N92-21113# Japan Society of Mechanical Engineers, Tokyo. **REPORT OF THE SUBCOMMITTEE MEETING STUDIES ON VARIOUS ENERGY UTILIZATION BY RC95 STIRLING CYCLE EQUIPMENT AND ENVIRONMENTAL CONSERVATION**

1991 180 p In JAPANESE (DE92-771920; ETDE/JP-MF-2771920) Avail: CASI HC A09/MF A02

The paper describes the results of the study on Stirling engines (SE) and various methods of heat utilization. The SE is a heat engine which is quiet, high in thermal efficiency, applicable to many heat sources, low on the pollution level, and the subjects for its wide spread are the price and durability. Developments for its commercialization have been made. The paper reports on the results of the 3rd meeting of the subcommittee formed in 1989. The application field of the SE is so wide, that it covers air conditioners, refrigerators, solar thermal conversion, utilization of waste heat and other fuels. Many small temperature difference Stirling engines are reported as characteristic SE. The SE has a bright future including developing countries in its target area. Furthermore, researches on space and ground use solar SE as a high-technology engine are being conducted actively, and refrigeration use Stirling equipment including Vuilleumier cycle has been developed. Some Japanese companies have succeeded in commercialization of air conditioning SE, and are entering into quantity production. DOE

N92-21114# New Energy Development Organization, Tokyo (Japan).

INVESTIGATION OF INTRODUCTION FORM OF LARGE SCALE FUEL CELLS, PART 1

Mar. 1991 209 p In JAPANESE; ENGLISH summary (DE92-772251; ETDE/JP-MF-2772251) Avail: CASI HC A10/MF A03

Investigations are conducted on a large scale phosphoric acid fuel cell (PAFC) power generation system for dispersed use of which immediate introduction is anticipated for the electric utility industry. The studies are made on the development trend, possible capacity for introduction, and optimum introduction/operation form. The operational temperature of PAFC is 200 C. Even on a small scale, PAFC power generation efficiency is high. The overall efficiency can be raised to 70 to 80 percent by the use of exhaust heat. It has good load responsibility and small environmental load. It is predicted that cost of a 5 MW commercial PAFC plant will be 200,000 to 250,000 yen/kW in the year 2000. The possible average introduction capacity will be 1872 MW/year for the coming 20 years, which indicates a considerably large marketability. Sites for installation considered are urban energy centers, substations, isolated islands, etc. In comparison between gas turbines and PAFC to be installed in the urban energy center, PAFC is more advantageous than gas turbines in terms of energy saving and economy if the cost of PAFC is reduced down to 250,000 yen/kW. DOE

N92-21115# New Energy Development Organization, Tokyo (Japan).

INVESTIGATION OF INTRODUCTION FORM OF LARGE SCALE FUEL CELLS, PART 2

Mar. 1991 240 p In JAPANESE (DE92-772252; ETDE/JP-MF-2772252) Avail: CASI HC A11/MF A03

This paper investigates the development of a large-capacity high-performance inverter for fuel cells. To develop such an inverter, large-capacity and high-speed power devices are required, and Gate Turn Off (GTO) thyristors and static induction (SI)

thyristors come into play. Estimating the properties of GTO and Si thyristors will be attained by the year 2000, an optimum inverter system using these properties is selected to conceive a concept plan for the inverter. As a result, in the inverter using (GTO) with a low switching frequency, an average value of three phases is to be controlled, and therefore, the inverter is weak in disturbances and imbalances to the power system. Further improvement is required such as a multiple trans-structure needing complicated secondary connections in order to reduce high frequencies. In the case of using the Si thyristor, adopting a relatively high frequency, an instantaneous value control system which controls the current of each phase individually is made possible. The inverter is strong in disturbances and imbalances to the power system. Therefore, in the case of minor ground faults of the power system, the operation can be continued without necessarily stopping the fuel cell power plant. However, development has been made for only small power devices so far. DOE

N92-22654# New Energy Development Organization, Tokyo (Japan).

SURVEY ON A COLD-ENERGY SUPPLY SYSTEM USING NATURAL ENERGY

Mar. 1991 99 p In JAPANESE; ENGLISH summary (DE92-769383; NEDO-P-9007) Avail: CASI HC A05/MF A02

This paper examines how unused cold energy sources are distributed and exist in the natural world and also evaluates the feasibility of the system to take out these cold energy sources by the use of solar energy, etc. and to supply them as cold energy to the surrounding area. Using a heat supply model building located at the dam-lake side, the system is outlined in the following three cases: dam-lake water and commercial electric power source system; dam-lake water and photovoltaic power generation system; and conventional energy system. These are viewed in terms of economy and effective energy utilization. When using a cold energy source below 10 C directly for the cold energy supply, a large effect is expected in terms of cost and energy. In a combination with the photovoltaic power generation, the problem is measured against snowfall, etc. The cold energy supply system which uses dam-lake water as a heat source of the heat pump has a large significance. A marked effect can be expected from a combination of an ice making heat pump and low temperature dam-lake water, in terms of effective energy utilization and cost reduction. DOE

N92-22758*# National Space Development Agency, Ibaraki (Japan).

LIFE EVALUATION OF 35AH NI-CD CELL IN JAPAN

S. KUWAJIMA (Sanyo Electric Co. Ltd., Sumoto (Japan)), NOLIMITS KAMIMORI (Sanyo Electric Co. Ltd., Sumoto (Japan)), and KEN NAKATANI (Sanyo Electric Co. Ltd., Sumoto, Japan) /In NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop p 379-416 Feb. 1992
Avail: CASI HC A03/MF A10

The National Space Development Agency of Japan (NASDA) began developing Nickel-Cadmium (Ni-Cd) cells for space use in 1985. Sanyo Electric was responsible for the cell design, manufacturing, and initial testing. The cell life was evaluated by NASDA in the Tsukuba Space Center (TKSC). The development is presently in the qualification Test (QT) phase. Recent life-cycle data for 35 Ah Ni-Cd cells are presented. Author

N92-23684# New Energy Development Organization, Tokyo (Japan).

INVESTIGATION ON EFFECTIVE PROMOTION OF GEOTHERMAL ENERGY DEVELOPMENT

Mar. 1991 125 p (DE92-783370; NEDO-P-9009) Avail: CASI HC A06/MF A02

Efficient and effective measures for promoting geothermal energy development are studied considering the present status and the problems of the geothermal energy development in Japan. To promote it smoothly, solutions to technical and socioeconomic problems are needed: There are many unclear points about the location and amount of geothermal resources. For geothermal energy development, it is necessary to establish a consensus of

procedures for surveying the development and settlement of selling prices, and risk sharing in the development. It is indispensable to consider an adjustment with natural parks and hot springs for the development. Troubles in making an adjustment are seen in many cases, and it is necessary to make efforts for that understanding. Improvement of economical efficiency of geothermal power generation is an important subject. From the above mentioned studies, the conclusion is obtained that it is most effective to make rules for development and to expand and strengthen resource prospecting by the government. If the rules are made, reduction of the development cost and shortening of the development period are planned, and the future of the geothermal energy business is expected to be promising. DOE

N92-25354# New Energy Development Organization, Tokyo (Japan).

ANALYSIS AND EVALUATION OF THE POSSIBILITY OF INTRODUCING PHOSPHORIC ACID FUEL CELLS

Mar. 1991 96 p (DE92-783369; NEDO-P-9027) Avail: CASI HC A05/MF A01

Each step in the manufacture of fuel cells is reviewed. The possibility of cost reduction in the process is investigated. Additionally, the feasibility of providing financial assistance for fuel cell buyers is investigated. Also, the present status and the future outlook of fuel cell development are discussed. In Japan, phosphoric acid fuel cells are beginning demonstration testing. A 200 kW test plant, for commercial and remote island use, has finished its demonstration test favorably. The test run of an 11 mW plant, for the production of electric power, is being conducted by a private company. The manufacture of each of the fuel cell's subsystems is semi-automated at this time. The costs are estimated to be reduced to 60 - 80 percent of the present costs in a 10 mW/year plant and to 50 - 60 percent of the present costs in a 100 mW/year plant. DOE

N92-30519# Midwest Research Inst., Golden, CO.

PERSPECTIVE ON PHOTOVOLTAIC AMORPHOUS SILICON

W. LUFT, B. STAFFORD, and B. VONROEDERN May 1992 9 p Presented at the 11th Review Meeting of the National Renewable Energy Laboratories: Photovoltaic Advanced Research and Development, Lakewood, CO, 13-15 May 1992 (Contract DE-AC02-83CH-10093) (DE92-010581; NREL/TP-412-4796; CONF-9205115-2) Avail: CASI HC A02/MF A01

Amorphous silicon is a thin film option that has the potential for a cost-effective product for large-scale utility photovoltaics application. The initial efficiencies for single-junction and multijunction amorphous silicon cells and modules have increased significantly over the past 10 years. The emphasis of research and development has changed to stabilized efficiency, especially that of multijunction modules. NREL has measured 6.3 percent to 7.2 percent stabilized amorphous silicon module efficiencies for U.S. products, and 8.1 percent stable efficiencies have been reported by Fuji Electric. This represents a significant increase over the stabilized efficiencies of modules manufactured only a few years ago. An increasing portion of the amorphous silicon U.S. Government funding is now for manufacturing technology development to reduce cost. The funding for amorphous silicon for photovoltaics by Japan over the last 5 years has been about 50 percent greater than that in the United States, and by Germany in the last 2 to 3 years, more than twice that of the U.S. Amorphous silicon is the only thin-film technology that is selling large-area commercial modules. The cost for amorphous silicon modules is now in the \$4.50 range; it is a strong function of plant production capacity and is expected to be reduced to \$1.00 to \$1.50/W(sub p) for plants with 10 MW/year capacities. DOE

N92-33090# Japan Solar Energy Society, Tokyo.

THE 1991 JAPAN SOLAR ENERGY SOCIETY. JAPAN WIND ENERGY ASSOCIATION JOINT CONFERENCE

20 Sep. 1991 434 p Conference held in Hokkaido (Japan), 20-21 Sep. 1991 (DE92-530733; CONF-9109393) Avail: CASI HC A19/MF A04

44 ENERGY PRODUCTION AND CONVERSION

This paper summarizes the lectures presented at the research presentation conference held by the Japan Solar Energy Society and the Japan Wind Energy Association. The contents include a lecture relating to photovoltaic cells intended for efficiency improvement; a lecture relating to a light power generation system including the field test reports, improvements on peripheral devices and output characteristics; a lecture relating to optical chemistry; a lecture relating to heat pumps utilizing solar heat and well water; a lecture relating air conditioning utilizing photovoltaic cells; a lecture relating to heat systems utilizing solar heat directly; a lecture relating to heat collection; a lecture relating to cold heat for cooling using earth tubes; a lecture relating to direct utilization of ground water heat and solar heat; a lecture relating to underground heat storage; a lecture relating to accumulation of cold heat and hot heat; a lecture relating to insolation on the amount of insolation and spectroscopy; a lecture relating to light collection intended of energy saving; a lecture relating to improving materials including light collecting plates and thin films; a lecture relating to development and characteristics of solar cars; and a lecture relating to wind energy. DOE

N92-33794# Power Reactor and Nuclear Fuel Development Corp., Oarai (Japan).

STUDY OF POTASSIUM TURBINE ELECTRIC GENERATOR SYSTEM [KARIUMU TABIN HATSUDEN SHISUTEMU NO KENTOU]

HIROSHI SEINO, KAZUO HAGA, HAJIME KATAOKA, and AKIRA OOTSUBO *In* NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 31 p 17 Jul. 1991 *In* JAPANESE Avail: CASI HC A03/MF A10

Structures and weight of the heat radiator panels (including heat pipes) and condensers as major constituent elements of the potassium Rankine cycle electric power generator systems of 300 kW output are reviewed and evaluated. An overall circuit diagram, major specifications, structure, weight, and heat transfer performance of the potassium Rankine cycle electric power generator system are estimated. Protection of radiator panels (including radiator fins and heat pipes) from meteoroids, structure and weight estimate of the potassium condensers are also described. Physical property trade-off of radiator fin materials, compatibility between metallic and alkaline materials, and potassium Rankine cycle circuit diagram are presented. The problems to be solved in the future are: (1) detailed examination of material strength to reduce structure weight; (2) methods of melting potassium or sodium for starting the system; (3) methods of supporting equipment taking into consideration the absorption of thermal expansion and acceleration (max. 8 g); (4) ensuring flow stability in the condenser; and (5) verification of relationship between heat transfer and pressure loss used in the design.

Author (NASDA)

N92-34064# New Energy Development Organization, Tokyo (Japan).

PROCEEDINGS OF THE 11TH BUSINESS REPORTING CONFERENCE OF THE NEDO GEOTHERMAL SUBCOMMITTEE KORATA MASAHIRO Oct. 1991 87 p *In* JAPANESE Conference held in Japan, Oct. 1991 (DE92-526277; ETDE/JP-MF-92526277) Avail: CASI HC A05/MF A01

The geothermal energy department at The New Energy and Industrial Technology Overall Development Organization carries out the following activities: a systematic identification of geothermal resource distribution all over Japan; discussions on selection of promising areas together with the criteria for exploration methods by volcanic thermal type; development of integrated analytic methods applied with high-level information processing technologies; site surveys on effectiveness of various physical exploration technologies; and surveys on environmental influence associated with developments. Developments under way on geothermal power generation systems include the following: development of an identification test for simplified medium-to-small size geothermal generation systems at the Kirishima area; and a 10 MW class plant for unused hydrothermal water resources. These

developments were made with respect to utilizing geothermal energy possessed by high-temperature rocks, artificial reservoir bed formation by means of the hydraulic fracturing method, evaluation of reservoir bed characteristics by means of well excavation, and circulating heat extraction tests. DOE

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ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

A92-10741

NITRIC ACID TRIHYDRATE PARTICLE FORMATION IN THE POLAR STRATOSPHERE AND ITS EFFECT ON NITRIC ACID TRANSPORT TO THE TROPOSPHERE

YASUNOBU IWASAKA and MASAHIKO HAYASHI (Nagoya University, Toyokawa, Japan) *Journal of Geomagnetism and Geoelectricity* (ISSN 0022-1392), vol. 43, no. 8, 1991, p. 667-675. refs

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Growth and sedimentation of type-I polar stratospheric clouds (type-I PSCs) particles including nitric acid are examined using a numerical model. The PSCs particles which grow in the upper particle layer have a large enough size (of about 10 microns) to descend rapidly to the tropopause within several days. In the lower part of PSCs layer, evaporation of HNO₃ from particulate matter occurs and acts as source of HNO₃ vapor. From the viewpoint of stratospheric HNO₃ distribution, the particle sedimentation effectively functions as a vertical transport mechanism of HNO₃ vapor from the upper PSCs layer to the lower layer and/or to the troposphere.

Author

A92-25501

REVIEW ON THE ABATEMENT OF HELICOPTER NOISE

TATSUYA MASUE *Japan Society for Aeronautical and Space Sciences, Journal* (ISSN 0021-4663), vol. 39, no. 455, 1991, p. 629-639. *In* Japanese. refs

Helicopter noise standards for landing, takeoff, and flight are discussed. Designs for reducing helicopter noise are presented, and the requirements for a quiet helicopter are addressed. Noise tests and results are analyzed. Y.P.Q.

A92-37895

EXTREMELY HIGH PROPORTIONS OF SOOT PARTICLES IN THE UPPER TROPOSPHERE OVER JAPAN

KIKUO OKADA, MIWAKO ILEGAMI, OSAMU UCHINO, YOSHINOBU NIKAIIDOU, YUJI ZAIZEN, YUKITOMO TSUTSUMI, and YUKIO MAKINO (Meteorological Research Institute, Tsukuba, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, no. 9, May 4, 1992, p. 921-924. refs

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Observation on tropospheric aerosol particles was carried out on 27 April 1991 over Tsukuba, Japan. Aerosol particles collected in the upper troposphere at 7.5 km altitude were studied by electron microscopy. Soot-containing particles were collected in a large number fraction (0.53) of the submicron particles. Such a high proportion of soot particles in the upper troposphere has not been reported in previous research. From the X-ray analysis, vanadium was also detected in some of the particles, indicating the origin of oil combustion. The oil-well fires in Kuwait are likely to be the origin of these soot particles. Calculated trajectories of the air suggested that these particles over Japan had circled the globe.

Author

A92-39103

TEMPORAL CHANGE OF NOISINESS OF HELICOPTER NOISE

SEIICHIRO NAMBA and SONOKO KUWANO (Osaka University, Toyonaka, Japan) *IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg,*

Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1171-1176. refs

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A method for measuring temporally and spatially varying sounds is described based on the methods of continuous judgment by category vs by selected description and used to study helicopter noise. The methods of continuous judgment and selected description by Namba and Kuwano (1988) are reviewed, and three experiments are conducted to study: (1) the instantaneous impression of noisiness using the category method; (2) the instantaneous impression of timbre using the selected-description method; and (3) the overall impression as defined by the semantic differential. Human subjects listening to DAT tapes of helicopter noise appear to have instantaneous impressions of noisiness that depend primarily on sound level. The effects of blade-slap noise during approach are shown to cause some deviation from the general results, and some underestimation of noisiness is associated with the converse phenomenon related to takeoff.

C.C.S.

A92-40502

ADSORPTION AND REACTION OF TRICHLOROFLUOROMETHANE ON VARIOUS PARTICLES

SHUZO KUTSUNA, KOJI TAKEUCHI, and TAKASHI IBUSUKI (National Research Institute for Pollution and Resources, Tsukuba, Japan) (The chemistry of the global atmosphere; International Symposium of the Commission for Atmospheric Chemistry and Global Pollution of IAMAP, 7th, Chamrousse, France, Sept. 5-11, 1990, Selected Papers. A92-40501 16-46) Journal of Atmospheric Chemistry (ISSN 0167-7764), vol. 14, no. 1-4, April 1992, p. 1-10. refs

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As a possible tropospheric sink of trichlorofluoromethane (CCl₃F), its adsorption and reaction on solid particles were studied with or without UV light longer than 310 nm. The adsorption and photodesorption occurred for most of the particles examined. The amounts depended not only on the BET surface area but also on the chemical property of the particles. The reaction rates were less than 0.1 percent/hr. The surface-induced degradation of CCl₃F in air was confirmed under photoirradiation at room temperature by the detection of Cl(-) or F(-) on some metal oxides. When the particles were pretreated with heat and evacuation, the reaction rate became larger and disproportionation of CCl₃F took place. It is suggested that the heterogeneous reaction of CCl₃F on particles is a possible tropospheric sink.

Author

N92-12345# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.

DEVELOPMENT OF ATMOSPHERIC DIFFUSION EVALUATION METHOD INCORPORATING THERMAL AND TOPOGRAPHICAL EFFECTS. PART 2: A LITERATURE REVIEW OF TURBULENCE MODEL UNDER TOPOGRAPHICAL CONDITION

KOICHI SADA and YOICHI ICHIKAWA Aug. 1989 42 p In JAPANESE; ENGLISH summary (DE90-503795; CRIE-T-89005) Avail: CASI (US Sales Only) HC A03

The development condition of turbulent models which has been introduced until now and their applicability for atmospheric diffusion forecasting was presented in this paper. The turbulent flow diffusion model is required for the forecasting, of which model calculates diffusion utilizing atmospheric turbulence, because atmosphere is the flow field with strong anisotropy. This flow field can be estimated by Mellor-Yamada model. When two equation models (k-epsilon model, etc) based on eddy viscosity concept are used, the method is required, which estimates convection turbulent flow quantity by the result of measurement for turbulence by mean of modification of the model, because the turbulence to be forecasted is isotropic. In order to approximately estimate complicated topography condition, adoption of a general coordinate system is most suitable. It requires establishment of meshes before the calculation is done; however, the linear interpolation method can establish the meshes for various topography and at the same

time be applicable for the calculation of atmospheric flow as a practical method.

DOE

N92-12346# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.

OBJECTIVE METHOD FOR ASSESSING MONITORING NETWORKS

HIROYUKI KATO and SAKAE NISHINOMIYA Oct. 1989 44 p In JAPANESE; ENGLISH summary (DE90-505577; CRIE-T-89007) Avail: CASI (US Sales Only) HC A03

The efficient atmospheric environment monitoring network was proposed applicable to various meteorological conditions under average emission conditions. The previously reported multivariate analysis method was applied to long interval observational records (emission conditions for three years, SO₂ and NO(x) concentrations at existing monitoring stations, and meteorological conditions), by improving some parts of the method for long term data. Through the analysis on a model area, a total optimum network was obtained adaptable to both SO₂ and NO(x) measurement, and both monitoring for general atmospheric environment and for stack gas emission of power plants. The network required only 18 stations (17 stations for SO₂, 16 for NO(x)) compared with 42 stations in the existing network. The analytical results obtained from continuous data for three years were also equal to the mean values of those obtained from data for each year.

DOE

N92-13494# Office of Technology Assessment, Washington, DC.

BIOTECHNOLOGY IN A GLOBAL ECONOMY. VOLUME 2, PART 1: CONTRACTOR DOCUMENTS

Jun. 1991 259 p (PB91-212068) Avail: CASI HC A12/MF A03

Volume 2, part 1 of this report is comprised of various papers relating to the biotechnology industry and its level of development in various countries. Major topics discussed include the current status of the industry in these countries, financing sources, future strategies, special projects being pursued, and technology transfer.

GRA

N92-13495# Office of Technology Assessment, Washington, DC.

BIOTECHNOLOGY IN A GLOBAL ECONOMY. VOLUME 2, PART 2: CONTRACTOR DOCUMENTS

Jun. 1991 259 p (PB91-212076) Avail: CASI HC A12/MF A03

Volume 2, part 2 of this report is comprised of four separate reports addressing various topics related to the biotechnology industry. Individual titles include the following: Biotechnology developments in Asia -- a financial perspective; Commercial biotechnology in Japan; Environmental biotechnology -- commercial prospects; and International biotechnology patenting.

GRA

N92-21395# New Energy Development Organization, Tokyo (Japan).

SURVEY ON THE EFFECTIVE USE OF CARBON DIOXIDE RELATED TO THE GLOBAL ENVIRONMENTAL ISSUES (APPLICATION TO EOR TECHNOLOGY USING CARBON DIOXIDE)

Mar. 1991 168 p In JAPANESE; ENGLISH summary (DE92-769373; NEDO-ITE-9001) Avail: CASI HC A08/MF A02

An effective method for using carbon dioxide injection into oil reservoirs for the fixation of carbon dioxide and its application to enhanced oil recovery (EOR) are presented. EOR using CO₂ is widely used as a tertiary recovery technique, particularly in the U.S. In the oil recovery, some of the CO₂ is generated as associated gas. The CO₂ is separated from the associated gas and recovered for recycling. It is possible to make the carbon dioxide fixation a completely closed system. The CO₂ volume required for EOR is estimated at 63 billion tons worldwide. The study introduces a total system for CO₂ emission in Japan. The system covers CO₂ recovery, liquefaction, and maritime transportation of the liquid CO₂ to oil producing countries. The

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price of CO₂ under the total system is higher than that of CO₂ emitted from the ordinary carbon dioxide gas field. However, when deduction for a cost of the CO₂ fixation to prevent the global warming is taken into consideration, the EOR system using CO₂ is economically viable, if the CO₂ cost for EOR operation in southeast Asia does not include the cost of CO₂ recovery and liquefaction in the total system. However, it is necessary to consider economy and viability individually and check the response to the EOR at each oil field. DOE

N92-22655# New Energy Development Organization, Tokyo (Japan).

INTRODUCTORY SURVEY FOR A LONG-TERM ENVIRONMENT MONITORING RELATED TO GEOTHERMAL ENERGY DEVELOPMENT (WILD ANIMALS), PART 1

Mar. 1991 125 p In JAPANESE; ENGLISH summary (DE92-769384; NEDO-P-9010-PT-1) Avail: CASI HC A06/MF A02

An investigation and a study of the literature are conducted aiming at establishing methods for a long-term monitoring of environmental effects of geothermal energy development on wild animals. Introduced is the present status of geothermal power plants and an environmental assessment of geothermal energy development in Japan. Relating to geothermal development, factors and elements are summarized which impact on wild animals and their relations, and problems on environmental conservation. Methods for studying wild animals assessment and studies of environmental assessment are outlined. The study of wild animals monitoring was conducted in Otake and Hatchobaru geothermal areas by NEDO entrusted to by Environment Agency and MITI, and monitoring examples in the study are summed up here. Methods of wild animals monitoring for geothermal energy development are considered, referring to and citing researches on natural environment monitoring methods by the Japan Highway Public Corporation. There are very few data and reports on wild animals environmental monitoring related to geothermal energy development. It is important to accumulate a lot of study examples and scientific knowledge and information to assess and monitor the environment for wild animals. DOE

N92-22656# New Energy Development Organization, Tokyo (Japan).

INTRODUCTORY SURVEY FOR A LONG-TERM ENVIRONMENT MONITORING RELATED TO GEOTHERMAL ENERGY DEVELOPMENT (WILD ANIMALS), PART 2

Mar. 1991 145 p Partly in JAPANESE; and ENGLISH (DE92-769385; NEDO-P-9010-PT-2) Avail: CASI HC A07/MF A02

This study is conducted to make adequate observations on and evaluations of effects of geothermal energy development on the environment and to obtain a social consensus, aiming at promoting development of geothermal resources. The main report puts together the literature on the methods for monitoring and assessing wild animals for the purpose of establishing monitoring methods including environmental impacts by the investigation method in the stage of the investigation of geothermal resources conducted by NEDO. Seventy domestic and 25 foreign data sets are collected excluding the data cited in the main report. Looking closely into this literature, 32 domestic and 15 foreign reports are selected as data sets for references for this study. These reports are compiled into one book, each itemizing its author, theme, report title and main result. As mentioned in the main report, the literature on wild animals monitoring related to geothermal energy development is very few. Therefore, these data sets can be valuable. DOE

N92-22658# New Energy Development Organization, Tokyo (Japan).

SURVEY FOR IMPACTS OF GLOBAL ENVIRONMENTAL ISSUES ON UTILIZATION OF ALTERNATIVE ENERGIES FOR OIL

Mar. 1991 296 p In JAPANESE; ENGLISH summary (DE92-769391; NEDO-P-9029) Avail: CASI HC A13/MF A03

This paper makes analyses of what policy and technological option each advanced industrial country thinks to take as measures for the global warming problem, at the same time clarifying the trends in international meetings. Analyses are also made of attitudes of developing countries and the international cooperation problem. Among the problems on global warming, an emphasis is placed on introduction of energy saving and what role the development of new energy plays. A positive group consisting mostly of West European countries is advocating a 'Go Quickly' approach, while the US representing a prudent group is developing a 'Go Slowly' approach. The US is considering afforestation which is useful to absorb CO₂ and methane recovery as technological options. West European countries regard CO₂ fixation as an important option. USSR, East European and developing countries consider that the most feasible and successful CO₂ measures are energy saving/improvement of energy efficiency and forest administration/afforestation. DOE

N92-23454# New Energy Development Organization, Tokyo (Japan).

PROMOTION OF INDUSTRIAL TECHNOLOGIES ON THE GLOBAL ENVIRONMENT

Mar. 1991 173 p In JAPANESE; ENGLISH summary (DE92-769377; NEDO-ITE-9002-5) Avail: CASI HC A08/MF A02

A global recycling system is proposed which controls CO₂ and also transports natural energy existing in a remote place. In terms of resource volume, the sun is the most feasible for a direct use as a non-fossil energy source which aims at a complete substitution of fossil fuels, especially as a renewable natural energy source. The desert is a place suitable for use of the sun because it is unused land and is rich in solar energy. For transportation of solar energy, it is effective to convert hydrogen to hydride for transport by tanker, in view of storage, initial capacity investment, maintenance and safety. For this, methanol is the most suitable as an energy carrier in terms of its hydrogen content and energy volume. Hydrogen is produced by electrolysis of water using electric power obtained from solar energy. Moreover, this system produces methanol by reducing CO₂ with this hydrogen and transports it by tanker. This system will succeed technically. DOE

N92-23455# New Energy Development Organization, Tokyo (Japan).

SURVEY ON SUBTERRANEAN DISPOSAL AND STORAGE TECHNOLOGY OF CO₂

Mar. 1991 97 p In JAPANESE; ENGLISH summary (DE92-769378; NEDO-ITE-9006) Avail: CASI HC A05/MF A02

This paper makes a feasibility study mainly on subterranean disposal and storage technology of CO₂ recovered from exhaust gas, etc. As for use of subterranean caves or spaces, the capacity is too small for long term storage and disposal. The use of subterranean strata is feasible, but detailed study is needed on site selection, environmental effects and CO₂ behaviors in the subterranean stratum. Regarding the use of subterranean water, a considerable amount of CO₂ disposal or storage is possible because CO₂ can be dissolved easily in subterranean water, if any feasible site is found. The use of subterranean water in water soluble gas fields, especially, is significant in consideration of the ground subsidence problem. Concerning geothermal power stations, CO₂ utilization to protect scaling is feasible, but a large amount of CO₂ disposal is not expected. Oil and gas fields are already utilized as a miscible flooding in enhanced oil recovery, but the problem is that in Japan there are few feasible sites and the disposal capacity is limited. Further studies should be made on subterranean behaviors of CO₂, evaluation of applicability to Japan and abroad and demonstration tests. DOE

N92-23733# New Energy Development Organization, Tokyo (Japan).

PROMOTION OF INDUSTRIAL TECHNOLOGIES ON THE GLOBAL ENVIRONMENT

Mar. 1991 128 p In JAPANESE; ENGLISH summary (DE92-769374; NEDO-ITE-9002-1) Avail: CASI HC A07/MF A02

The development is studied of a method for a systematic

estimation of the aggregate CO₂ emission by linking together CO₂ estimated from the industry-related analysis and that emitted from each industrial sector. Use of this method aims at pointing out a new industrial system. Calculating unit requirement (per unit amount of production) of CO₂ from each industrial sector, cash flow obtained from industrial relation and CO₂ emitted from each industrial sector are linked. This method enables quantitative evaluation of changes of CO₂ emission due to changes in the industrial structure in each area and at the same time the method is effective in studying the spread to other areas and the whole Japan. Changes of the aggregate CO₂ emission nationwide can also be estimated. Energy substitution in each industrial sector and degree of contribution to energy conservation can be evaluated. The possibility of applying it to international industry relation is foreseen in the future. It is necessary to enhance accuracy by integrating CO₂ to enhance accuracy by integrating CO₂ emitted from the process itself which uses no energy, CO₂ emission caused by waste disposal and effects of resources recycling into the method. DOE

N92-23734# New Energy Development Organization, Tokyo (Japan).

PROMOTION OF INDUSTRIAL TECHNOLOGIES ON THE GLOBAL ENVIRONMENT

Mar. 1991 267 p In JAPANESE; ENGLISH summary (DE92-769375; NEDO-ITE-9002-2) Avail: CASI HC A12/MF A03

An evaluation method similar to the industry relation analysis is first proposed, aimed at establishing a quantitative evaluation method of CO₂ emission control effects of various CO₂ control technologies. A concept of an accumulated CO₂ emission unit (phi) is used as an evaluation index. The premise of this concept is that input-output flow relations of materials can be expressed linearly in each unit of the process, a combination form in each unit is already known, and phi values for raw materials, energy, costs of utility, equipment, labor and management are already known as initial conditions. If such conditions are satisfied, accumulated CO₂ per product unit amount can be calculated in the actual process by this method, and effects of CO₂ control technology can be evaluated quantitatively by comparing sizes of phi for the identical product. This method is applied to electric power, iron and steel, oil refinery and cement industries, and the present status is described. In the 1991 FY analysis, however, phi values for costs of equipment, labor and management are not set as initial conditions. DOE

N92-24023# New Energy Development Organization, Tokyo (Japan).

PROMOTION OF INDUSTRIAL TECHNOLOGIES ON THE GLOBAL ENVIRONMENT

Mar. 1991 196 p In JAPANESE; ENGLISH summary (DE92-769376; NEDO-ITE-9002-4) Avail: CASI HC A09/MF A03

The paper examines the technological trend mainly in elemental technologies for CO₂ reduction from a standpoint of chemical technology, and makes an assessment and an analysis based on the global balance of materials and energy. As for chemical CO₂ reduction measures, those on a long term basis are: development of solar energy utilization technology, chemical and electrochemical fixation technology to be combinedly used therewith. Measures on a short- to medium-term basis are: further promotion of energy saving related technology (utilization of low temperature waste heat, improvement of utilization efficiency, highly selective synthesis technique), technology of effective chemical conversion to high convenient energy mediums, promotion of chemical technologies for environment protection such as measures against acid rain, use of clean fuels, measures against greenhouse effect gases other than CO₂. It is necessary to promote in well balance development of elemental technologies on the short-, medium- and long-term basis as well as the overall application of various measures. The important subject studied is to secure primary energy sources except fossil fuels and to develop energy conservation technology. DOE

N92-24024# New Energy Development Organization, Tokyo (Japan).

SURVEY ON OPTIMIZATION OF CO₂ DISPOSAL SYSTEM AND CARBON UTILIZATION TECHNOLOGY

Mar. 1991 101 p In JAPANESE

(DE92-769381; NEDO-ITE-9003) Avail: CASI HC A06/MF A02

Studies were made on the possibility of combining a technology for extracting carbon materials from fossil fuels and a CO₂ fixation and utilization system and also on effects of CO₂ emission control. Carbon materials which attract attention hereafter are carbon fiber, vitreous carbon, graphite intercalation compounds and new diamond, etc. Pitch based carbon fiber, in particular, is the most promising because of its potential and wide field of application. The present technical problems were studied of pitch based carbon fiber. HP-grade carbon fiber is used, and its present price and future target price are set at 20,000 and 5,000 yen/kg, respectively. The price of oil pitch as fuel is set at 20,000 yen/kl, the same as that of heavy oil. In view of an economic use per CO₂ emission volume, it is much more effective to use oil pitch as carbon fiber with high-value added than to use it as fuel. If a unit price of hundreds yen/kg is realized, carbon fiber is expected to be used also in the concrete reinforced fiber market which has a production of 2.9 million tons/year. This will contribute to CO₂ emission control. DOE

N92-29229*# Fukuoka Univ. (Japan). Dept. of Applied Physics.

LONG TERM STRATOSPHERIC AEROSOL LIDAR MEASUREMENTS IN KYUSHU

MOTOWO FUJIWARA In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 1-2 Jul. 1992

Avail: CASI HC A01/MF A04

Lidar soundings of the stratospheric aerosols have been made since 1972 at Fukuoka, Kyushu Island of Japan. Volcanic clouds from eruptions of La Soufriere, Sierra Negra, St. Helens, Uluwan, Alaid, unknown volcano, and El Chichon were detected one after another in only three years from 1979 to 1982. In July 1991 strong scattering layers which were originated from the serious eruptions of Pinatubo in June and were almost comparable to the El Chichon clouds were detected. Volcanic clouds from pinatubo and other volcanos mentioned are examined and carefully compared to each other and to the wind and temperature which was measured by Fukuoka Meteorological Observatory almost at the same time as the lidar observation was made. H.A.

N92-29232*# Tokyo Metropolitan Univ. (Japan). Dept. of Electronics and Information Engineering.

MEASUREMENTS OF STRATOSPHERIC PINATUBO AEROSOL EXTINCTION PROFILES BY A RAMAN LIDAR

MAKOTO ABO and CHIKAO NAGASAWA In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 11-12 Jul. 1992

Avail: CASI HC A01/MF A04

The Raman lidar has been used for remote measurements of water vapor, ozone and atmospheric temperature in the lower troposphere because the Raman cross section is three orders smaller than the Rayleigh cross section. We estimated the extinction coefficients of the Pinatubo volcanic aerosol in the stratosphere using a Raman lidar. If the precise aerosol extinction coefficients are derived, the backscatter coefficient of a Mie scattering lidar will be more accurately estimated. The Raman lidar has performed to measure density profiles of some species using Raman scattering. Here we used a frequency-doubled Nd:YAG laser for transmitter and received nitrogen vibrational Q-branch Raman scattering signal. Ansmann et al. (1990) derived tropospheric aerosol extinction profiles with a Raman lidar. We think that this method can apply to dense stratospheric aerosols such as Pinatubo volcanic aerosols. As dense aerosols are now accumulated in the stratosphere by Pinatubo volcanic eruption, the error of Raman lidar signal regarding the fluctuation of air density can be ignored. Author

N92-29234*# Meteorological Research Inst., Tsukuba (Japan).
LIDAR OBSERVATIONS OF STRATOSPHERIC AEROSOL LAYER AFTER THE MT. PINATUBO VOLCANIC ERUPTION
 TOMOHIRO NAGAI, OSAMU UCHINO, and TOSHIFUMI FUJIMOTO /In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 17-20 Jul. 1992
 Avail: CASI HC A01/MF A04

The volcano Mt. Pinatubo located on the Luzon Island, Philippines, had explosively erupted on June 15, 1991. The volcanic eruptions such as volcanic ash, SO₂ and H₂O reached into the stratosphere over 30 km altitude by the NOAA-11 satellite observation and this is considered one of the biggest volcanic eruptions in this century. A grandiose volcanic eruption influences the atmosphere seriously and causes many climatic effects globally. There had been many impacts on radiation, atmospheric temperature and stratospheric ozone after some past volcanic eruptions. The main cause of volcanic influence depends on stratospheric aerosol, that stay long enough to change climate and other meteorological conditions. Therefore it is very important to watch stratospheric aerosol layers carefully and continuously. Standing on this respect, we do not only continue stratospheric aerosol observation at Tsukuba but also have urgently developed another lidar observational point at Naha in Okinawa Island. This observational station could be thought valuable since there is no lidar observational station in this latitudinal zone and it is much nearer to Mt. Pinatubo. Especially, there is advantage to link up these two stations on studying the transportation mechanism in the stratosphere. In this paper, we present the results of lidar observations at Tsukuba and Naha by lidar systems with Nd:YAG laser. Author

N92-29242*# National Inst. for Environmental Studies, Tsukuba (Japan).

OBSERVATION OF STRATOSPHERIC OZONE WITH NIES LIDAR SYSTEM IN TSUKUBA, JAPAN

H. NAKANE, S. HAYASHIDA, Y. SASANO, N. SUGIMOTO, I. MATSUI, and A. MINATO /In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 45-48 Jul. 1992

Avail: CASI HC A01/MF A04

Lidars are expected to play important roles in an international monitoring network of the stratosphere such as the Network for the Detection of Stratospheric Change (NDSC). The National Institute for Environmental Studies (NIES) in Tsukuba constructed an ozone lidar system in March 1988 and started observation in August 1988. The lidar system has a 2-m telescope and injection locked XeCl and XeF excimer lasers which can measure ozone profiles (15-45 km) and temperature profiles (30-80 km). From December 1991, lidar observations have been carried out in which the second Stokes line of the stimulated Raman scattering of a KrF laser has been used. Ozone profiles obtained with the NIES lidar system are compared with the data provided by the SAGE II satellite sensor. Results showed good agreement for the individual and the zonal mean profiles. Variations of ozone with various time scales at each altitude can be studied using the data obtained with the NIES ozone lidar system. Seasonal variations are easily found at 20 km, 30 km, and 35 km, which are qualitatively understood as a result of dynamical and photochemical effects. Systematic errors of ozone profiles due to the Pinatubo stratospheric aerosols have been detected using multi-wavelength observation. Author

N92-29250*# National Inst. for Environmental Studies, Tsukuba (Japan).

THREE-WAVELENGTH LIDAR MEASUREMENTS OF PINATUBO AEROSOL AND ITS OPTICAL PROPERTIES

Y. SASANO, I. MATSUI, and S. HAYASHIDA /In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 75-78 Jul. 1992

Avail: CASI HC A01/MF A04

Enhanced stratospheric aerosols due to Mt. Pinatubo eruption have been measured using a YAG laser-based three wavelength lidar and a YAG laser-based large-scale lidar. Temporal variation

of the integrated backscatter coefficient derived from the backscatter coefficient profiles were obtained. The present paper describes some results of optical properties analysis using lidar data obtained since Dec., 1991 when the main body of aerosols started to appear over Japan. The derived properties of the Pinatubo aerosols are extinction to backscatter ratios, wavelength dependencies of backscatter coefficients and extinction coefficients, and optical thickness. The analysis is based on the assumption of similarity in backscatter profiles for three wavelengths which are derived from lidar signals using the Fernald equation with assumed extinction to backscatter ratios. H.A.

N92-29277*# National Inst. for Environmental Studies, Tsukuba (Japan).

INFRARED PULSE-LASER LONG-PATH ABSORPTION MEASUREMENT OF CARBON DIOXIDE USING A RAMAN-SHIFTED DYE LASER

ATSUSHI MINATO, NOBUO SUGIMOTO, and YASUHIRO SASANO /In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 181-183 Jul. 1992

Avail: CASI HC A01/MF A04

A pulsed laser source is effective in infrared laser long-path absorption measurements when the optical path length is very long or the reflection from a hard target is utilized, because higher signal-to-noise ratio is obtained in the detection of weak return signals. We have investigated the performance of a pulse-laser long-path absorption system using a hydrogen Raman shifter and a tunable dye laser pumped by a Nd:YAG laser, which generates second Stokes radiation in the 2-micron region. Author

N92-29638# Institute of Energy Economics of Japan.

GLOBAL-WARMING PROBLEM AND GLOBAL ECONOMIC MODELS

30 Sep. 1991 200 p

(DE92-514557; IEE-SR-225) Avail: CASI HC A09/MF A03

This report describes results of investigation, comparison and analysis of various global models to analyze what policies are effective for reduction of greenhouse effect gases as measures for prevention of the global warming and building of a well-balanced energy supply structure. The paper deals with global models like a general equilibrium macroeconomic model on a cost for reduction of CO₂ emission and an energy economy simulation model. The results of the simulation of global models indicate that there are big differences in optimum carbon tax rate between the models, but a drop in GDP growth rate affected by emission control is very low in each model. These results seem to be attractive. However, in the method using these models in which improvement of energy efficiency is regarded as a main factor, there is still some doubt whether CO₂ emission can be practically controlled in the long term. DOE

N92-70964 National Inst. of Polar Research, Tokyo (Japan).

JARE DATA REPORTS. NO. 153 (METEOROLOGY 24).

ANTARCTIC CLIMATE RESEARCH DATA. PART 2: RADAR AND MICROWAVE RADIOMETER DATA AT SYOWA STATION, ANTARCTICA, MARCH - DECEMBER 1988

MAKOTO WADA, TAKAO HOSHIAI, ed., MASAKI EJIRI, ed., KATSUTADA KAMINUMA, ed., IKUO KUSHIRO, ed., MASAYUKI TAKAHASHI, ed., OKITSUGU WATANABE, ed., TORAO YOSHIKAWA, ed., YOSHIYUKI FUJII, ed., and TAKEO HIRASAWA, ed. Mar. 1990 100 p (ISSN 0075-3343)

Avail: CASI HC A05

A five-year program of Antarctic Climate Research (ACR) was planned to be carried out at Syowa, Asuka, and Mizuho Stations, surrounding the ice sheet and sea ice area from 1987 to 1991 by the Japanese Antarctic Research Expedition (JARE) as part of the international cooperating World Climate Research Program (WCRP) (Yamanouchi, 1989). The main research subjects are: (1) interannual variation of Antarctic atmosphere; (2) sea-ice-atmosphere interaction; (3) variation of ice sheet and ice shelf; and (4) ice core analysis. In JARE-29 (the 2nd year of this

program), the items related to the interannual variation of Antarctic atmosphere were observed. The observational data of clouds and precipitation, which are useful for studying short- and long-term variation, are shown in this report. Author

46

GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

A92-10117

VISCOSITY WAVES AND THERMAL-CONDUCTION WAVES AS A CAUSE OF 'SPECULAR' REFLECTORS IN RADAR STUDIES OF THE ATMOSPHERE

W. K. HOCKING, SHOICHIRO FUKAO, MAMORU YAMAMOTO, TOSHITAKA TSUDA, and SUSUMU KATO (Kyoto University, Japan) Radio Science (ISSN 0048-6604), vol. 26, Sept.-Oct. 1991, p. 1281-1303. refs

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A new theory is presented to explain the cause of the atmospheric structures which are responsible for specular reflection of radar signals from the atmosphere. Evidence recorded with the middle and upper atmosphere (MU) VHF radar at Shigaraki in Japan, as well as previous reports of specular reflections from other radars and at other frequencies, are used to support the assertions. The theory postulates that the reflectors are produced by a form of highly damped wave which arises in a fluid as a result of the effects of viscosity and thermal conduction. They occur at altitudes where gravity waves are partially reflected and in the vicinity of gravity wave critical levels but are particularly prevalent when such reflections and critical level interactions occurs in a laminar region of the atmosphere. Author

A92-10520

MAXIMUM LIKELIHOOD PARAMETER ESTIMATION OF SUDDENLY-COMMENCING EQUATORIAL P12 PULSATIONS

M. ITONAGA and T.-I. KITAMURA (Kyushu University, Fukuoka, Japan) Planetary and Space Science (ISSN 0032-0633), vol. 39, Sept. 1991, p. 1271-1281. refs

(Contract MOESC-02740217)

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The data sequence is assumed to be an output from a finite impulse response filter with a superposition of suddenly-commencing, exponentially damped sinusoids as an input. A maximum likelihood (ML) method is proposed to estimate the parameters of the damped sinusoids directly from the filtered data. Equatorial P12 pulsations are guessed to be such a superposition. In addition, since the signal-to-noise ratio is improved and the undesired components are rejected by filtering, the filtered data is usually analyzed. The proposed ML method is a new one for spectral estimation. The ML method was applied to an equatorial P12 event which was observed simultaneously at two stations, and evidence to strongly support the suggestion of the global cavity resonance mode of P12 waves was found in the event. That is, the P12 showed a very similar discrete spectral structure, despite a large longitudinal separation of the stations. By means of the proposed ML method, more detailed and precise discussions on P12 pulsations than expected from the customary data analysis methods, will become possible. Author

A92-10640

F-REGION SEASONAL BEHAVIOR AS MEASURED BY THE MU RADAR

S. FUKAO, Y. ONISHI, T. TSUDA, M. YAMAMOTO, S. KATO (Kyoto University, Uji, Japan), W. L. OLIVER (Kyoto University, Uji, Japan; Boston University, MA), T. TAKAMI, and T. SATO (Kyoto University, Japan) (Thermospheric and ionospheric dynamics; Symposium, Exeter, England, July 1989, Selected Papers.

A92-10626 01-46) Journal of Atmospheric and Terrestrial Physics (ISSN 0021-9169), vol. 53, June-July 1991, p. 599-618. refs (Contract NSF INT-89-03050; NSF ATM-89-00042)

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A model of the ion-vector velocity is extended to one-year by using a larger base of MU radar incoherent-scatter (IS) data which permits analysis of the seasonal variations in ionospheric drifts, density, and temperatures. Patterns of electron-density and plasma-temperature behavior are also analyzed for relationships with the solstices and equinoxes. The timing of the diurnal change of direction of the neutral wind with respect to the time of sunset is found to determine the seasonal behavior of electron density which is also related to the neutral composition behavior. A high-altitude O(+) layer and a low-altitude molecular-ion layer vie for greatest density, and during the summer and/or times of strong magnetic disturbance the molecular-ion layer is stronger. Other effects are described including the dominance of electron density over mean equinox daytime F-region electron and ion temperatures. C.C.S.

A92-12257

EMERGENT RADIATION FROM THE ATMOSPHERE BOUNDED BY THE TWO HALVES OF THE LAMBERT SURFACE WITH DIFFERENT ALBEDOS

T. TAKASHIMA and K. MASUDA (Meteorological Research Institute, Tsukuba, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 183, no. 2, Sept. 1991, p. 225-236. refs

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For the evaluation of the effect of the nonuniform surface albedo to the emergent radiation from the atmosphere, the emergent radiation from the atmosphere bounded by the two-halves of the Lambert surface with different albedos is computed. The principal plane is assumed to be perpendicular to the boundary of surfaces. For quantitative analysis, results are compared with those of the atmosphere-uniform surface model, where the multiple scattering is considered. The numerical simulation exhibits the extraordinary effect near the surface boundary of different albedos. The effect decreases exponentially with the distance from the boundary. It is a function of the observational position, difference of surface albedos, optical thickness and aerosol type. Author

A92-12937

FOUR-BEAM MEASUREMENTS OF IONOSPHERIC STRUCTURE WITH THE MU RADAR DURING THE LOW-LATITUDE AURORAL EVENT OF 20-23 OCTOBER 1989

WILLIAM L. OLIVER (Kyoto University, Uji, Japan; Boston University, MA), SHOICHIRO FUKAO, TOMOYUKI TAKAMI, TOSHITAKA TSUDA, and SUSUMU KATO (Kyoto University, Uji, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 18, Nov. 1991, p. 1975-1978. refs

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The MU radar was used to observe the ionospheric F-region electron density simultaneously in four oblique beams during the geomagnetic storm of 20-23 October 1989, when the first significant auroral display over Japan since 1960 was observed. The four beams, separated by about 250 km horizontally in the F region, observed drastically different behavior, with independent and extreme changes occurring on time scales of one minute during the period of peak activity, indicating a strongly structured ionosphere streaming over the radar. Cases were observed in which, simultaneously, a deep trough was seen in one beam, densities exceeding 4×10^6 /cu cm were seen in another, and a normal ionosphere was seen in a third. During the most disturbed periods the F-layer peak height appeared to rise to 800 km altitude in one beam while it remained near 500 km in another. Author

A92-13834

MULTIPLE BEAM OBSERVATIONS OF MID-LATITUDE IONOSPHERIC DISTURBANCES BY THE MU RADAR

TOMOYUKI TAKAMI, SHOICHIRO FUKAO, SUSUMU KATO, TOSHITAKA TSUDA, MANABU D. YAMANAKA, MAMORU YAMAMOTO, TAKUJI NAKAMURA (Kyoto University, Uji, Japan),

W. L. OLIVER (Boston University, MA), and TORU SATO (Kyoto University, Yoshida, Japan) (Equatorial aeronomy; International Symposium, 8th, San Miguel de Tucuman, Argentina, Mar. 21-27, 1990, Selected Papers. A92-13826 03-46) *Journal of Atmospheric and Terrestrial Physics* (ISSN 0021-9169), vol. 53, Aug. 1991, p. 773-779. refs

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Typical patterns of midlatitude ionospheric disturbances and their horizontal traveling characteristics are presented. Data were obtained from the MU radar multiple beam observations of the incoherent scatter power profile. It is concluded that isolated disturbances travel primarily southward in disturbed conditions, while no preferred direction is observed in quiet conditions. O.G.

A92-15477

ELECTRON TEMPERATURE MEASUREMENTS CARRIED OUT BY JAPANESE SCIENTIFIC SATELLITES

K.-I. OYAMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) (Enlarged space and ground data base for ionospheric modelling; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meeting C5/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-15451 04-46) *Advances in Space Research* (ISSN 0273-1177), vol. 11, no. 10, 1991, p. 149-158. refs

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An overview of satellite-borne electron-temperature (ET) probes is presented with special attention given to the geophysical data collected by the probes and applications of the data. The principle of ET measurement and the probe circuitry are discussed, and reference is given to the specific details of several satellite missions. The observed ETs in the magnetic anomaly region are shown to be higher than usual, and ET measurement inside plasma bubbles is reported. The anisotropy of ETs is discussed based on measurements from three sensors on the same satellite, and simultaneously derived data are mentioned for ET and energy-distribution function. The data discussed were derived over a period of about one solar cycle and can be utilized for the ionospheric modeling undertaken for the IRI. C.C.S.

A92-15801

FURTHER EVIDENCE OF TRIGGERING CHORUS EMISSIONS FROM WAVELETS IN THE HISS BAND

KATSUMI HATTORI, MASASHI HAYAKAWA (Nagoya University, Toyokawa, Japan), DOMINIQUE LAGOUTTE, MICHEL PARROT, and FRANCOIS LEFEUVRE (CNRS, Laboratoire de Physique et Chimie de l'Environnement, Orleans, France) *Planetary and Space Science* (ISSN 0032-0633), vol. 39, Nov. 1991, p. 1465-1472. refs

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The results of detailed special analyses and direction finding for ELF data containing simultaneous hiss and chorus have been reported on the basis of the data observed on-board GEOS 1 satellite in the outer magnetosphere at a high geomagnetic latitude. A combination of the present results with those from previous equatorial studies has yielded the following findings: (1) each chorus element has a tendency to originate from the hiss band and is asymptotic to the hiss band; (2) the intensity and occurrence of the chorus are closely correlated with the intensity of the underlying hiss; (3) the hiss band exhibits structures or wavelets and the existence of the causative wavelet at the foot of each chorus element is noted; (4) when triggering chorus is expected from a wavelet near the upper edge of the hiss band, the duration of the wavelet increases with decreasing intensity; (5) very similar azimuthal angle values are noticed for both the hiss and chorus, suggesting that both phenomena come from the same source region. Author

A92-15948

GLOBAL CHARACTERISTICS OF FIELD-ALIGNED ACCELERATION PROCESSES ASSOCIATED WITH AURORAL ARCS

KAZUO SHIOKAWA (Nagoya University, Toyokawa, Japan) and HIROSHI FUKUNISHI (Tohoku University, Sendai, Japan) *Journal*

of Geomagnetism and Geoelectricity (ISSN 0022-1392), vol. 43, no. 9, 1991, p. 691-719. refs

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The particle and aurora image data obtained from the DMSP-F6 and -F7 satellites are analyzed in order to study the global characteristics of field-aligned acceleration processes associated with auroral arcs. The intensities of auroral emissions for 5577-A, 6300-A, and N2(1PG) are calculated using the observed electron flux and the two-stream electron transport code to show that the fluxes of precipitating electrons are sufficient to produce visible auroral arcs. Global distributions are obtained for the field-aligned potential difference, magnetospheric electron density and thermal energy, electron heating rate during the acceleration, and auroral emission intensities for magnetic quiet and active periods, respectively. It is found that the field-aligned potential difference increases as magnetospheric electron density and adiabatic field-aligned conductivity decrease, suggesting the constant-current generator for the magnetosphere-ionosphere current circuit. C.A.B.

A92-15949

OBSERVATION OF EARTH'S ORBITAL MOTION USING COSMIC-RAY COMPTON-GETTING EFFECT AT MATSUSHIRO UNDERGROUND STATION

SHINICHI YASUE, SATORU MORI, KAZUOKI MUNAKATA (Shinshu University, Matsumoto, Japan), ALAA A. DARWISH, and A. A. BISHARA (Alexandria University, Egypt) *Journal of Geomagnetism and Geoelectricity* (ISSN 0022-1392), vol. 43, no. 9, 1991, p. 771-776. refs

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Data observed at the Matsushiro underground station located at an effective vertical depth of 220 mwe underground for the period 1980-1990 are used to investigate the earth's motion Compton-Getting effect on the solar diurnal variation of cosmic ray intensity. The analysis is made for two periods of solar activity, the quiet period for averaged sunspot numbers less than 60 (1984-1988), and the active period (1980-1984 and 1988-1989). It is shown that, for the quiet period, the difference E-W diurnal vector has a phase of 22.5 ± 1.3 hr in LT and an amplitude of 0.030 ± 0.007 percent. With a clockwise rotation of this E-W vector by the right angle, it is compared with that expected from the earth's motion Compton-Getting effect. The observed and the expected vector are in fair agreement. For the active period, the observed E-W diurnal vector shows some contribution from the solar diurnal anisotropy, in addition to the Compton-Getting effect. It is inferred that for the last solar active period the upper cutoff energy of solar diurnal anisotropy is as high as that for the threshold of 220 mwe depth underground. C.A.B.

A92-16179

SECULAR VARIATIONS IN HELIUM ISOTOPE RATIOS IN AN ACTIVE VOLCANO - ERUPTION AND PLUG HYPOTHESIS

YUJI SANO, KENJI NOTSU, JUN-ICHIRO ISHIBASHI, GEORGE IGARASHI, and HIROSHI WAKITA (Tokyo, University, Japan) *Earth and Planetary Science Letters* (ISSN 0012-821X), vol. 107, no. 1, Oct. 1991, p. 95-100. refs

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The present study reports secular variations in He-3/He-4 and He-4/Ne-20 ratios for October 1986 to April 1991 in gas samples from a 90 C steam well located about 3 km north of Mt. Mihara, an active volcano in Japan. The He-3/He-4 and Ne-4/Ne-20 ratios increased anomalously from 4.18 R(atm) to 4.59 R(atm) and from 0.93 and 1.08, respectively, about 3 mo prior to the explosive eruption of the volcano on October 4, 1990. The He-3/He-4 enhancement may be related to the concurrent decrease in the height of volcanic smoke at the central cone. C.A.B.

A92-17930

ATMOSPHERIC CO2 AND CH4 OBSERVED DURING THE FLIGHT OF INTERNATIONAL STRATO/TROPOSPHERIC AIR CHEMISTRY I

HISAYUKI Y. INOUE, HIDEKAZU MATSUEDA, TAKASHI MIDORIKAWA, and YUKIO SUGIMURA (Meteorological Research

Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, March 1991, p. 3-10. refs
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Air samples were collected during the test flight of International Strato/Tropospheric Air Chemistry I from Tokyo, Japan to Biak, Indonesia in March 1989. The samples collected at four to five km were subjected to CH₄ and CO₂ measurement initially, then CO₂ was extracted to measure the carbon isotope ratio. The relationship between carbon isotope ratio and the concentration of atmospheric CO₂ shows that the high concentration over and near the Japan Islands and a hump at 13 deg N are created by the fossil fuel consumption and/or land plant respiration. R.E.P.

**A92-17931
MEASUREMENT OF LIGHT NONMETHANE HYDROCARBONS (C2-C5) OVER THE WESTERN PACIFIC DURING THE INSTAC-I FLIGHT CAMPAIGN (1989.3)**

FUMIO SAKAMAKI and HAJIME AKIMOTO (National Institute for Environmental Studies, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, March 1991, p. 11-19. refs
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During the INSTAC-I flight campaign in March 1989, 21 air samples were collected and 8 light nonmethane hydrocarbons were measured with an FID-gas chromatograph. The mean concentrations of the hydrocarbons measured were 1.30 ppb (ethane), 0.372 ppb (propane), 0.175 ppb (n-butane), 0.075 ppb (isobutane), 0.139 ppb (n-pentane), 0.039 ppb (iso-pentane), 0.006 ppb (neopentane), and 0.179 ppb (acetylene). All hydrocarbons showed a slight tendency to increase over the tropics. No marked difference was recognized between the samples obtained during the southbound and northbound flights. The sum of relative reactivities of these light hydrocarbons to methane was estimated to be about 26 percent of methane, which signifies that the effect of light hydrocarbons on atmospheric chemistry in the unpolluted troposphere cannot be ignored. Author

**A92-17932
MEASUREMENTS OF NITRIC OXIDE AND OZONE IN THE TROPOSPHERE FROM MID-LATITUDES TO EQUATOR**

YUTAKA KONDO, YASUNOBU IWASAKA, AKIRA IWATA (Nagoya University, Toyokawa, Japan), TOSHIHIRO OGAWA (Tokyo, University, Japan), YUKIO SUGIMURA, and YUKIO MAKINO (Meteorological Research Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, March 1991, p. 21-29. Research supported by Science and Technology Agency of Japan. refs
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Mixing ratio of nitric oxide (NO) and ozone were measured on board an aircraft over the western Pacific ocean between 7th and 10th of March, 1989. The latitude range covered was from 35 deg N to 1 deg S. NO mixing ratio at 4.5 km varied between 10 and 45 pptv at latitudes between 32 and 15 deg N and the average NO mixing ratio was about 20 pptv. A peak in NO mixing ratio reaching 45 pptv was encountered near 20 deg N during both southbound and northbound flights. The average NO mixing ratio at latitudes between 10 deg N and the equator was about 10 pptv. The latitudinal variation in the ozone mixing ratio was basically similar to that of NO, suggesting larger sources of NO and ozone at midlatitudes than at lower latitudes. Author

**A92-18162
MEASUREMENT OF CHANGES IN LOWER TROPOSPHERIC OZONE DISTRIBUTION THROUGH ONE DAY USING A COMPACT UV SOLAR-BLIND LIDAR**

MICHIHIRO UCHIUMI, TAKASHI SHIBATA, and MITSUO MAEDA (Kyushu University, Fukuoka, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Oct. 1991, p. 513-521. Research supported by MOESC. refs
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Results of successive measurements of atmospheric ozone up to an altitude of 3 km over a 24-hr period made using DIAL are presented. The performance of the compact ozone lidar developed

are evaluated in the actual lidar observations, and it is demonstrated that the lower tropospheric ozone can be measured in daytime without deterioration in the SN ratio if the solar-blind effect is considered. The errors in the ozone concentration due to aerosols, NO₂, and SO₂ are discussed and the data are corrected for the aerosols. C.A.B.

**A92-18163
INTERACTIONS BETWEEN GRAVITY WAVES AND THE DIURNAL TIDE IN THE MESOSPHERE AND LOWER THERMOSPHERE**

SABURO MIYAHARA (Kyushu University, Fukuoka, Japan) and JEFFREY M. FORBES (Boston University, MA) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Oct. 1991, p. 523-531. refs

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Interactions between breaking internal gravity waves with phase speeds of 0, +/-10, +/-20, +/-30 m/s, and the diurnal tide in the mesosphere and lower thermosphere (70-120 km) are investigated using a time-dependent numerical model of the tide. The gravity wave breaking and stress are calculated using a modified Lindzen's parameterization making allowance for interactions with a diurnally varying zonal wind superimposed on a zonal mean wind field. In order to avoid difficulties with the WKB approximation used in the parameterization, the interactions are only considered in the extratropics. However, the gravity wave stress is shown to suppress the amplitude of the diurnal tide at all latitudes in the upper mesosphere and lower thermosphere. It is also shown that gravity wave stresses modified by the diurnal tide induce significant semidiurnal and terdiurnal tides in the mesosphere and thermosphere. Author

**A92-18392
MEDIAN IONOSPHERIC HEIGHT VARIATIONS OVER A SUNSPOT CYCLE IN THE AUSTRALIAN-JAPANESE LONGITUDINAL SECTOR**

L. A. HAJKOWICZ (Queensland, University, St. Lucia, Australia) Planetary and Space Science (ISSN 0032-0633), vol. 39, Dec. 1991, p. 1607-1615. refs

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Ionosonde data are collected over a period of 6 years in the sector to study the monthly median virtual height of the F-region from sunspot maximum to minimum. In the local winter and spring the nocturnal maximum of the median height decreases toward the equator and reaches a peak in both hemispheres 1-2 years after sunspot maximum. A second diurnal maximum is also noted and related to the wave disturbance caused by the supersonic motion of the sunrise terminator. The propagation of traveling ionospheric disturbances induced by magnetic storms is theorized to be affected by the background height variations. C.C.S.

**A92-20491
COMPARISON OF NEW NUTATION SERIES WITH NUMERICAL INTEGRATION**

J. SOUCHAY and H. KINOSHITA (National Astronomical Observatory, Mitaka, Japan) Celestial Mechanics and Dynamical Astronomy (ISSN 0923-2958), vol. 52, no. 1, 1991, p. 45-55. refs

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The nutation for the rigid earth, both in the low and the high frequencies, is computed by numerical integration using the basic equations of Kinoshita (1977). The results are compared against the new tables of the nutation for the rigid earth model in Kinoshita and Souchay (1990). Very small long period residuals are obtained, with a discrepancy of 0.06 mas sin Omega in longitude, -0.04 mas cos Omega in obliquity, without out-of-phase components. The total short-period residuals do not exceed 0.1 mas in longitude, 0.06 mas in obliquity. The results support the validity of the new tables. V.L.

A92-20501

SOLAR WIND-MAGNETOSPHERE INTERACTION DURING THE POSSIBLE ENCOUNTER OF COMET HALLEY'S TAIL IN 1910 INFERRED FROM MID-LATITUDE GEOMAGNETIC FIELD DISTURBANCES

T. IYEMORI and T. ARAKI (Kyoto University, Japan) *Journal of Geomagnetism and Geoelectricity* (ISSN 0022-1392), vol. 43, no. 10, 1991, p. 783-795. Research supported by Japan Society for the Promotion of Science. refs

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Geomagnetic disturbances from the period April to June 1910 are analyzed to detect the possible effects of the Comet Halley on the solar wind-magnetosphere interaction. Data from six midlatitude geomagnetic observatories are used to calculate the longitudinally symmetric (i.e., Dst) and asymmetric fields. An application of a linear prediction filter to separate the solar wind dynamic pressure effect on the disturbances from that of the ring current, suggests that there exists a compressional variation in the Dst on May 18 which is around or slightly earlier than the time of estimated cometary tail encounter. The normal-run magnetogram from Agincourt on the dayside and that from Lu-Kia-Pang on the nightside, also indicate rather strong (i.e., 30-40 nT) compressional variation. The disturbances characteristic to the solar wind-magnetosphere interaction under the southward IMF condition and that of the ring current development are seen during the period. These results suggest that the earth's magnetosphere had been affected by a dense cometary plasma tail with high dynamic pressure, though the solar wind-magnetosphere interaction typically observed under the southward IMF condition had been taking place during the encounter. Author

A92-20504

AN ESTIMATION OF A VORTEX DYNAMO IN THE LOW-LATITUDE MAGNETOSPHERIC BOUNDARY LAYER

SENKICHI SHIBUYA (Yamagata University, Japan) *Journal of Geomagnetism and Geoelectricity* (ISSN 0022-1392), vol. 43, no. 10, 1991, p. 63-869. refs

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The effect of the vortex dynamo in the low-latitude magnetospheric boundary layer on the field-aligned current is estimated using a simple vortex model for the transport of the electromagnetic energy from the solar wind in the low-latitude magnetospheric boundary layer. Results provide an explanation of the diurnal flow pattern of field-aligned current as the duct propagation between the magnetosphere and the ionosphere. I.S.

A92-20505

EFFECT OF VIBRATIONAL TEMPERATURE OF NITROGEN ON THE ELECTRON ENERGY DISTRIBUTION DATA

HIROSHI AMEMIYA and YOSHYUKI SHIGUEOKA (Institute of Physical and Chemical Research, Wako, Japan) *Journal of Geomagnetism and Geoelectricity* (ISSN 0022-1392), vol. 43, no. 10, 1991, p. 871-881. refs

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Thermal electron energy distributions in the midlatitude ionosphere measured at dusk on September 16, 1983 by a Japanese rocket S-310-14, launched from Kagoshima Space Center, showed bumps appearing on the high energy tail at about 0.3 eV between 98.3 and 171 km. Densities of such nonthermal electrons were about 0.01 of those of thermal electrons. Above the height of 180 km (F-layer), distributions had no bumps on the tail and only slightly deviated from Maxwellian. The mechanism of the appearance of nonthermal electrons is discussed from a point of superelastic collisions between vibrationally excited nitrogen molecules and thermal electrons. Author

A92-21027

A STUDY OF ANOMALOUS UNDERGROUND ELECTRIC FIELD VARIATIONS ASSOCIATED WITH A VOLCANIC ERUPTION

YUKIO FUJINAWA, TEIJI KUMAGAI (National Research Institute for Earth Science and Disaster Prevention, Tsukuba, Japan), and KOZO TAKAHASHI (Communications Research Laboratory,

Koganei, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, Jan. 3, 1992, p. 9-12. refs

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Continuous measurements of vertical subsurface geoelectric fields in the frequency range dc - 0.6 Hz and 1-3 kHz (VLF) are reported. Anomalous field variations of the ULF band are observed a few days prior to, and a month after, a minor volcanic eruption of Mt. Mihara. The variations displayed essentially distorted pulses, rising sharply initially, gradually decreasing, and then suddenly falling off. The electric field variations also seem to extend to the VLF band. It is felt that the anomalous electric field variations were caused by electrokinetic phenomena induced by variations of hydrothermal circulation around the crater, or by variations of crack density, due to volcanic activity. Author

A92-21028

ELEMENT PARTITIONING BETWEEN MAJORITE AND LIQUID - A SECONDARY ION MASS SPECTROMETRIC STUDY

HISAYOSHI YURIMOTO (Tsukuba, University, Japan) and EIJI OHTANI (Tohoku University, Sendai, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, Jan. 3, 1992, p. 17-20. refs

(Contract MOESC-60430015; MOESC-63840024; MOESC-61840026; MOESC-63540654)

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SIMS was applied to measure the trace element abundances in majorite and the ultramafic liquid equilibrating at high pressure and temperature for the first time, and was proved to be useful for high pressure experimental petrology. The analysis by SIMS was made to determine the abundance of 15 lithophile elements, one siderophile, and two chalcophile elements. An electron microprobe analysis was also made to obtain the major element abundance. Some lithophile elements (Al, Be, and V) are enriched in majorite, whereas the lithophile elements (Li, B, Na, K, Ca, Ti, Zr, Y, La, Sm, Gd, and Hf), and siderophile and chalcophile elements (Co, Cu, Zn) are favored in the liquid. These results give important constraints for the genesis of komatiites and chemical heterogeneity in the Archean mantle. Author

A92-23374

MIDDLE ATMOSPHERE DYNAMIC COUPLING WITH THE LOWER AND UPPER ATMOSPHERE - MU RADAR RELATED RESEARCH

SHOICHIRO FUKAO (Kyoto, University, Uji, Japan) *STEP GBRSC News*, vol. 1, Aug. 1991, p. 13, 14.

The radar system of the Shigaraki MU Observatory of the Radio Atmospheric Science Center, Kyoto University, is described in terms of its operational parameters and with respect to potential applications to the study of momentum and energy transport through the middle atmosphere. The middle atmosphere can be studied by means of data regarding internal gravity waves, mesosphere/thermosphere dynamic coupling, the homopause and turbopause, and the meridional circulation. The MU Radar System is a monostatic pulse radar with an active phased-array system that permits the measurement of winds, waves, and atmospheric parameters, as well as neutral winds with an added passive meteor-radar capability. C.C.S.

A92-26158

FRACTAL ANALYSIS OF FAULT SYSTEMS IN JAPAN AND THE PHILIPPINES

NAOKO MATSUMOTO, KIYOSHI YOMOGIDA, and SATORU HONDA (Hiroshima, University, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, Feb. 21, 1992, p. 357-360. refs

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Complexity of fault systems in Japan and the Philippines is quantitatively measured using fractal dimension. The areas studied are the Median Tectonic Line, Izu, Unzen on the Japanese Islands, and the fault system yielded by the Philippine earthquake which occurred on July 16, 1990. Results are summarized as follows: fractal dimensions along the Median Tectonic Line vary between 1 and 1.3. The Unzen area gives the highest fractal dimension

(1.4) of all the areas studied, which implies that the fault system there is the most complex. Fractal dimension of the fault system associated with the Philippine earthquake is smaller than 1. It can be interpreted that this fault system is almost one-dimensional, truncated by numerous gaps of various sizes. Author

A92-26801
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. II - SOLAR ACTIVITY
 FUMIHIKO TOMITA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 3-17. In Japanese. refs

A geomagnetic storm on November 30, 1988 is analyzed for its possible solar origin. The results are as follows: (1) the effect of a solar flare activity is scarcely impossible; (2) the effect of disappearing filaments is possible; and (3) the effects of a corotating high-speed region or a coronal hole cannot be denied. Author

A92-26802
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. III - SOME FEATURES OF IONOSPHERIC DISTURBANCES OBSERVED BY THE DIGISONDE 256 SYSTEM AND ROUTINE IONOSONDES
 SEIJI IGI, HISAMITSU MINAKOSHI, MIKITOSHI NAGAYAMA, HISAO KATO, and TETSUO TAKEUCHI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 19-32. In Japanese. refs

An ionospheric structure is investigated with ionograms observed during a period of ionospheric disturbances between November 30 and December 1, 1988 by the Digisonde 256 system. A general feature of the ionosphere is presented with ionospheric summary plots processed by an automatic ionogram-processing system. A sequential plot of virtual height clarifies that observations of satellite trace are due to an extreme tilt structure of the ionosphere. The observations of this satellite's echo indicate the existence of a traveling ionospheric disturbance. Equatorial anomaly is developed up to the latitude of Kokubunji station. The Es layer is often observed although it is not dominant in the winter season. Author

A92-26803
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. IV - IONOSPHERIC FEATURES AS SEEN BY OBLIQUE IONOGRAMS
 TETSUO TAKEUCHI and KIYOSHI IGARASHI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 33-38. In Japanese. refs

Using an oblique ionospheric sounding network, oblique ionograms were obtained every 15 minutes at Kokubunji during severe ionospheric disturbances on November 30 through December 1, 1988. Vertical sounding HF signals (1-25 MHz) were received. Oblique ionograms on the night of November 30 exhibit scattered echoes due to an anomalous propagation of the signals in addition to normal echoes due to a normal propagation. It is found that the anomalous propagation occurred when the maximum observable frequency increased greatly and also that the scattered echoes appeared more frequently and severely on the southernmost path. Author

A92-26804
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. V - IONOSPHERIC OSCILLATIONS REVEALED BY HF DOPPLER MEASUREMENT TECHNIQUE
 SYOJI KAINUMA, KOHJI INAMORI, HIROMITSU ISHIBASHI, TAKESHI ISOBE, and TADAHKO OGAWA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 39-45. In Japanese. refs

An HF Doppler network detected some ionospheric oscillations during a medium-scale geomagnetic storm on November 30 through December 1, 1988. In association with the sudden storm commencement at 1700 JST on November 30, HF Doppler frequency deviations belonging to an SCF (+ -) type, which is believed to be caused by the westward and subsequent eastward

ionospheric electric fields, were observed. Large-scale traveling ionospheric disturbances detected on the night of November 30 by the ionosondes (h'F) also appeared in the HF Doppler data.

Author

A92-26805
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. VI - RELATIONS BETWEEN MAGNETOSPHERIC AND IONOSPHERIC DISTURBANCES
 TAKASHI TANAKA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 47-52. In Japanese. refs

A low-latitude penetration of magnetospheric electric fields was observed in the evening sector on November 30, 1988, during a magnetic storm. In this storm, asymmetrical disturbances in the low-latitude magnetic field started immediately after the sc and lasted for long periods. During the intervals, intensifications of low-latitude electric fields were observed associated with the expansion of the auroral oval. Author

A92-26806
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. VII - OCCURRENCE OF IONOSPHERIC SCINTILLATIONS AND ROLE OF THE EASTWARD ELECTRIC FIELD

TAKASHI MARUYAMA and SATOSHI OKAMOTO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 53-62. In Japanese. refs

Severe ionospheric scintillations at frequencies up to about 20 GHz were observed in Japan in association with a magnetic storm on November 30, 1988. Scintillation data from earth stations spread over Japan together with variations of the background ionosphere derived from ionosonde-chain data are analyzed. At most of the stations, the scintillations began in the same half-hr period. Ionospheric virtual height and critical frequency varied anomalously throughout the night. A close examination of the data suggests that the sudden increase of the eastward electric fields is a leading cause of the generation of irregularities through the $E \times B$ instability mechanism. Author

A92-26807
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. VIII - $E \times B$ INSTABILITY IN THE MIDLATITUDE IONOSPHERE
 TAKASHI MARUYAMA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 63-74. In Japanese. refs

Macroscopic instability in the nocturnal ionospheric F region at midlatitudes is examined when eastward external electric fields exist. The instability growth rate is calculated considering plasma in the entire flux tube. Ion-density distribution is obtained by a modeling approach in which the ion continuity equations for $O(+)$ and $H(+)$ are solved. The gravitational Rayleigh-Taylor mode is stable at midlatitudes higher than the crests of the equatorial anomaly, while the $E \times B$ mode is unstable at all latitudes when the electric fields are eastward. The net-instability growth rate is negative in the narrow region around the magnetic field line which crosses the equator at 1100 km and penetrates the F-layer peak near 18 deg in magnetic latitude. In the lower and higher latitude regions, the ionosphere becomes unstable. In the lower latitude region the instability accounts for the generation of plasma bubbles, while in the higher latitude region it accounts for generation of plasma ducts, plasma blobs observed in the topside ionosphere, and mid-latitude bottomside spread F. Author

A92-26808
IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. IX - VHF-20 GHZ IONOSPHERIC SCINTILLATIONS

ICHIZOH NISHIMUTA, SYOGO KAMISHIKIRYO, HIROTO MITSUDOME, HISAMITSU MINAKOSHI, and TADAHKO OGAWA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 75-81. In Japanese. refs

46 GEOPHYSICS

In association with a geomagnetic storm severe ionospheric scintillations of 136 MHz, 12, and 20 GHz radio waves from geostationary satellites ETS-II, BS-2, and CS-3, respectively, were observed. Surprisingly, a 2.5 dB peak-to-peak amplitude of the 20 GHz scintillations is attained. These scintillations are simultaneously accompanied by both range-type spread-F and an abnormal increase in total electron content due to a well developed equatorial anomaly. It is inferred that the 12 and 20 GHz scintillations were caused by localized very-small scale irregularities in the F-region. In addition to this peculiar event some characteristics are described of 12-GHz ionospheric scintillations observed in the past. Author

A92-26809

IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. X - IONOSPHERIC SCINTILLATIONS AND TOTAL ELECTRON CONTENT OBSERVED BY ETS-II SATELLITE

HISAMITSU MINAKOSHI, SATOSHI OKAMOTO, HIROTO MITSUDOME, ICHIZO NISHIMUTA, SHOGO KAMISHIKIRYO, and KENROU NOZAKI Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 83-91. In Japanese. refs

Ionospheric disturbances during a geomagnetic storm on November 30 through December 1, 1988 are investigated by using data of the ionospheric total electron content and scintillations obtained by the ETS-II 136-MHz beacon experiment with routine ionosonde data along the same meridian. Significant enhancements in total electron content are noted as is the simultaneous occurrence of severe ionospheric scintillations in the lower-middle-latitude region after the sunset. The phenomena are theorized to be a consequence of the equatorial anomaly enhanced by an eastward field due to a magnetospheric source and an E x B instability leading to small-scale irregularities. Author

A92-26810

IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. XI - SCINTILLATION OBSERVATIONS BY NNSS SATELLITES

KAZUHIRO OHTAKA, MANABU KUNITAKE, and TADAHIKO OGAWA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 93-100. In Japanese. refs

During the ionospheric disturbances associated with a geomagnetic storm on November 30 through December 1 1988 severe nighttime ionospheric scintillations of 150- and 400-MHz transmissions from six U.S. Navy Navigation Satellite System (NNSS) satellites were detected. The latitudinal extent of the scintillation region changes from time to time, and at certain times it covers the latitudes between 20 and 50 deg N corresponding to the latitudes from the satellite's horizon to horizon. The behavior of the scintillation region is caused by temporal and spatial changes of electron-density irregularities appearing in the storm-time F-region and can be related to the scintillations in the frequency band from 136 MHz to 20 GHz simultaneously observed using various geostationary satellites at other stations. Author

A92-26813

IONOSPHERIC DISTURBANCES DURING NOVEMBER 30 TO DECEMBER 1, 1988. XIV - SUMMARY

TADAHIKO OGAWA Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 9, Feb. 1990, p. 117-123. In Japanese. refs

The very large ionospheric disturbance phenomena during November 30 to December 1 1988, are briefly summarized. Severe ionospheric scintillations of 136 MHz-20 GHz radio waves emitted from many geostationary satellites and an orbiting satellite were detected in Japan on the night of November 30. The most interesting observation is that of the first 20-GHz scintillations at Yamagawa which seem to be associated with a northward-expanding equatorial anomaly accompanied by very strong, small-scale electron-density irregularities. The irregularities appearing over Japan also caused spread-F on ionograms and abnormal propagation of HF radio waves. A VHF wave from a

foreign country was abnormally detected in association with the equatorial anomaly. Judging from time variations of the h'F and foF2 data (obtained at five ionosonde stations) and of the world-wide geomagnetic fields, it is inferred that the time development of the present ionospheric disturbances is fundamentally consistent with an existing disturbance scenario deduced from analyses of past high-GHz scintillation events.

Author

A92-26868

MULTIPLE THIN FILM METHOD FOR SIMULTANEOUS DETECTION OF SULFATE AND NITRATE IONS IN INDIVIDUAL PARTICLES AND ITS APPLICATION TO ATMOSPHERIC AEROSOLS

GONG W. QIAN, HIROSHI TANAKA, MASAHIKO YAMATO, and YUTAKA ISHIZAKA (Nagoya University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 629-640. refs
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A new thin film chemical method has been developed for the simultaneous detection of individual sulfate-containing and nitrate-containing aerosols. It is based on the reactions of the sulfate ion with barium chloride and of the nitrate ion with nitron. Multiple thin films are prepared by successive depositions of nitron and barium chloride. Both reactions of sulfate with barium chloride and of nitrate with nitron proceed in the octanol saturated atmosphere. Under this reaction condition, existence of sulfate and nitrate in individual particles is indicated by the appearance of the Liesegang rings and of a bundle of needle-like crystals, respectively. These reactions are reproducible and not interfered with carbonate and chloride ions. The method is specific for sulfate and nitrate ions and can be applied to soluble sulfate and nitrate. Examples of the method applied to atmospheric aerosols are shown. Particular interest is concerned with the observation of the mixed salt of sulfate-nitrate in the atmosphere. Author

A92-28094

MAGNETOSPHERIC SUBSTORMS AND NIGHTTIME HEIGHT CHANGES OF THE F2 REGION AT MIDDLE AND LOW LATITUDES

C. A. REDDY and A. NISHIDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A3, March 1, 1992, p. 3039-3061. refs
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The published plots of 15-min interval values of h'F2 and the minimum virtual height of the ionospheric F2 region, at five Japanese stations spread over 26-45 deg N and 128-142 deg E, are used to show that there are frequent rapid increases and less frequent decreases of h'F2 by 100-200 km in about 2 hr with near-simultaneous start and end at all five stations in the postmidnight hours and at three to five stations in the premidnight hours. The nighttime h'F2 changes are found to be associated with magnetospheric substorms as manifested in the bay disturbances in the auroral latitude magnetograms, indicating that the h'F2 changes are caused by the east-west electric field disturbances in the ionosphere during the substorms. The substorm time east-west electric fields in the nighttime ionosphere can be quantified and characterized from the vast data base of 15-min interval h'F2 values. C.A.B.

A92-28544

A MODEL AND EXPERIMENTAL STUDY OF EVAPORATION FROM BARE-SOIL SURFACES

JUNSEI KONDO, NOBUKO SAIGUSA (Tohoku University, Sendai, Japan), and TAKESHI SATO (National Research Institute for Earth Science and Disaster Prevention, Shinjo, Japan) Journal of Applied Meteorology (ISSN 0894-8763), vol. 31, March 1992, p. 304-312. refs
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This study presents a model for estimating evaporation from bare-soil surfaces. In the model, the evaporation is parameterized with the soil-water content for the upper 2 cm of the soil, and the

heat and water transport within the soil layer below 2 cm is explicitly described by the heat conduction and moisture diffusion equations. Experiments on evaporation from loam packed in pans are carried out; the present model well simulates the observed evaporation and vertical profiles of soil temperature and water content. Long time simulations of evaporation by the present model are compared with the force-restore method and the bucket model for a drying period of over several months. The decrease in the evaporation rate for the bucket is comparatively small. The sensitivity of the model on the wind velocity is tested. P.D.

A92-31283* National Aeronautics and Space Administration, Washington, DC.

MAGNETIC FLUX ROPES IN 3-DIMENSIONAL MHD SIMULATIONS

TATSUKI OGINO (Nagoya University, Toyokawa, Japan), RAYMOND J. WALKER, and MAHA ASHOUR-ABDALLA (California, University, Los Angeles) IN: Physics of magnetic flux ropes. Washington, DC, American Geophysical Union, 1990, p. 669-678. Research supported by MOESC. refs (Contract NAGW-78; NGL-05-007-004)

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The interaction of the solar wind and the earth's magnetosphere is presently simulated by a 3D, time-dependent, global MHD method in order to model the magnetopause and magnetotail generation of magnetic flux ropes. It is noted that strongly twisted and localized magnetic flux tubes similar to magnetic flux ropes appear at the subpolar magnetopause when the IMF has a large azimuthal component, as well as a southward component. Plasmoids are generated in the magnetotail after the formation of a near-earth magnetic neutral line; the magnetic field lines have a helical structure that is connected from dawn to dusk. O.C.

A92-31522

ON THE LOCATION OF CAUSATIVE ATMOSPHERIC OF VERY LOW LATITUDE WHISTLERS AND THEIR MAGNETOSPHERIC PROPAGATION MECHANISM

M. HAYAKAWA (Nagoya University, Toyokawa, Japan), S. SHIMAKURA, M. MORIIZUMI (Chiba University, Japan), and K. OHTA (Chubu University, Kasugai, Japan) (URSI, Joint Symposium on Radio Propagation in the Ionosphere and Magnetosphere: Theory and Application, Prague, Czechoslovakia, Aug. 28-Sept. 5, 1990) Radio Science (ISSN 0048-6604), vol. 27, Mar.-Apr. 1992, p. 335-339. refs

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The causative atmospherics of very-low-latitude whistlers whose ionospheric exit regions have previously been determined at geomagnetic latitudes, 10-13 deg, are located in order to aid the understanding of the magnetospheric propagation mechanism of very-low-latitude whistlers. It is found that the causative atmospherics of very-low-latitude whistlers are very widely distributed in a range from 500 to 2500 km from the conjugate point of whistler ionospheric exit region previously determined. This fact lends further support to a previous implication that magnetospheric preferred paths supporting field-aligned propagation are extremely rare in occurrence and that there has existed a preferred and stable magnetospheric path in a very restricted location on the day of high whistler activity. Author

A92-31524

ION CYCLOTRON EMISSIONS OBSERVED BY THE SATELLITE AKEBONO IN THE VICINITY OF THE MAGNETIC EQUATOR

YOSHIYA KASAHARA, AKIRA SAWADA, MASAYUKI YAMAMOTO, IWANE KIMURA (Kyoto University, Japan), SUSUMU KOKUBUN, and KANJI HAYASHI (Tokyo, University, Japan) (URSI, Joint Symposium on Radio Propagation in the Ionosphere and Magnetosphere: Theory and Application, Prague, Czechoslovakia, Aug. 28-Sept. 5, 1990) Radio Science (ISSN 0048-6604), vol. 27, Mar.-Apr. 1992, p. 347-362. refs (Contract MOESC-63420016)

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In wave observations by a wave measuring instrument named

ELF on board the Akebono satellite, interesting ELF emissions in the frequency ranges above the cyclotron frequencies of He(+) and/or O(+) ions have been detected. It is proposed that these emissions are due to electromagnetic ion cyclotron waves, which might have been generated by the ion cyclotron resonant instability due to a temperature anisotropy of hot H(+) ions, trapped along the magnetic field lines around the geomagnetic equatorial plane. In order to confirm the characteristics of these ELF emissions, statistical characteristics, refractive index, and wave normal direction of the emissions are first estimated. The propagation characteristics of these ELF emissions are examined by ray tracing for ion cyclotron waves in the magnetosphere using both cold and hot plasma models. Author

A92-33553

A GLOBAL SIMULATION OF THE MAGNETOSPHERE WITH A LONG TAIL - NO INTERPLANETARY MAGNETIC FIELD

A. KAGEYAMA (Hiroshima University, Japan), K. WATANABE, and T. SATO (National Institute for Fusion Science, Nagoya, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A4, April 1, 1992, p. 3929-3943. refs

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The study performs a global 3D MHD simulation of the magnetosphere with a long tail (about 100 RE). Concentration of the plasma sheet current was found to occur preferentially at 14-18 RE on the tail side of the earth, from which it is inferred that, magnetically, this is the most fragile region of the tail structure. In the present initial value problem, reconnection occurs at 15-20 RE in the tail and develops into a large lump of plasma surrounded by reconnected field lines, a plasmoid, which is ejected tailward. The time scale of the plasmoid formation and ejection process is of the order of several hours, when no IMF exists. After one plasmoid is ejected, reconnection occurs again in the plasma sheet, and a second plasmoid is formed and ejected. It is inferred that a magnetosphere that has a sufficiently long tail and a neutral sheet is fragile and subject to plasmoid formation. It is also shown that the hot plasma, when mapped down to the ionosphere along the field lines, encompasses the auroral oval in agreement with the DE satellite observations. P.D.

A92-34031

SUBDUCTING SLABS STAGNANT IN THE MANTLE TRANSITION ZONE

YOSHIO FUKAO, MASAYUKI OBAYASHI (Nagoya University, Japan), HIROSHI INOUE (International Institute of Seismology and Earthquake Engineering, Tsukuba, Japan), and MASAKAZU NENBAI (Pasco Corp., Tokyo, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. B4, April 10, 1992, p. 4809-4822. refs

(Contract MOESC-63420013)

Copyright

The study investigates the P wave velocity structure beneath the Western Pacific on the basis of International Seismological Center first arrival data, with particular attention given to the deep structure beneath the Wadati-Benioff zone. The whole mantle was discretized into blocks with finer blocks in the region of interest to obtain the velocities of all the blocks. A first-order smoothness constraint was imposed to suppress the possible fluctuation of the solution around the initial model. The resolution was examined by calculating the resolving kernels for selected blocks and by reconstructing the checkerboard test patterns of velocity perturbation and the test structures of the subducting lithosphere. It is suggested that descending slabs of the lithosphere in the Western Pacific tend to be stagnant in the transition zone under the subtle control of the 670-km discontinuity under the Japan arc. Although stagnant slab materials eventually descend into the lower mantle, they no longer maintain their original configuration below the 670-km discontinuity. C.A.B.

A92-34238

DOMINANT VERTICAL SCALES OF GRAVITY WAVES IN THE MIDDLE ATMOSPHERE OBSERVED WITH THE MU RADAR AND ROCKETSONDES

Y. MURAYAMA, T. TSUDA, M. YAMAMOTO, T. NAKAMURA (Kyoto University, Uji, Japan), T. SATO (Kyoto University, Japan), S. KATO, and S. FUKAO (Kyoto University, Uji, Japan) *Journal of Atmospheric and Terrestrial Physics* (ISSN 0021-9169), vol. 54, Mar.-Apr. 1992, p. 339-346. refs
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Wind motions in the altitude range of 5-90 km by means of the MU radar, rocketsondes and radiosondes are simultaneously observed. Dominant vertical scales of wind fluctuations due to gravity waves were 2-5 km in the lower stratosphere, about 5-15 km in the upper stratosphere and longer than 15 km in the mesosphere. The increase in the vertical scale with altitude is interpreted in terms of the saturation of upward propagating gravity waves. In the stratosphere, the observed vertical wavenumber spectra showed smaller amplitudes and more gradual slopes than the model values. Furthermore, the wind velocity variance in the stratosphere increases exponentially with an e-folding height of about 9 km, implying that the gravity waves were not fully saturated. On the other hand, the spectra in the upper stratosphere and mesosphere agreed fairly well with the model spectra. The variance in the mesosphere seems to cease increase of the wave amplitudes and agrees reasonably well with the model value. Author

A92-34716

AIRBORNE MEASUREMENTS OF OPTICAL PROPERTIES OF TROPOSPHERIC AEROSOLS OVER AN URBAN AREA

MASAYUKI TANAKA, TADAHIRO HAYASAKA, and TERUYUKI NAKAJIMA (Tohoku University, Sendai, Japan) *Meteorological Society of Japan, Journal* (ISSN 0026-1165), vol. 68, June 1990, p. 335-345. Research supported by MOESC. refs
Copyright

Aircraft measurements of aerosol sizes, intensities of direct-solar and circumsolar (aureole) radiations, and upward and downward fluxes of solar radiation were carried out over Nagoya, a typical urban area in Japan, using an optical particle counter, an aureolemeter, and spectral pyranometers, respectively. Vertical profiles of optical thicknesses and volume spectra of aerosols were retrieved by inverting measured aureole intensities. The obtained values were utilized to estimate the absorption indices of aerosols from the downward flux measurements. The results are summarized as follows: (1) the concentration and the vertical stratification of tropospheric aerosols vary considerably day by day, (2) bimodal volume spectra of aerosols with radii smaller and larger than about 0.5 microns generally prevail in the troposphere, and (3) estimated values of the imaginary index of refraction of tropospheric columnar aerosols are within the range of 0.005-0.014 in the visible region and 0.008-0.020 in the NIR region. Corresponding values for the haze layer are slightly larger. Author

A92-35045

OPTICAL PROPERTIES OF ATMOSPHERIC AEROSOLS DERIVED FROM CZCS DATA

S. MUKAI, I. SANO (Kanazawa Institute of Technology, Ishikawa, Japan), K. MASUDA, and T. TAKASHIMA (Meteorological Research Institute, Tsukuba, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 943-946. refs
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Chlorophyll density distribution near the sea surface is derived from Nimbus-7 CZCS data through atmospheric correction and biooptical algorithms. It is shown that an appropriate aerosol model is the key factor to pursue atmospheric correction based on multiple scattering calculations in an atmosphere-ocean model. An algorithm to estimate the aerosol models suitable for the CZCS image of interest is described. As a result, it is possible to estimate the optical properties of atmospheric aerosols, e.g., refractive indices and/or size distribution, referring to the CZCS band 4 data. It is emphasized that this approach provides improved images of chlorophyll density distribution. I.E.

A92-35199

THE MONTE CARLO SIMULATION OF RADIATIVE PROCESS IN THE ATMOSPHERE-GROUND SYSTEM

Y. KAWATA, A. HATAKEYAMA, T. KUSAKA, and S. UENO (Kanazawa Institute of Technology, Nonoichi, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1707-1710. refs
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The Monte Carlo method was used to solve the radiative transfer problem in the atmosphere in the presence of a rugged terrain surface. In the Monte Carlo method, photon histories were created using the phase function, the albedo of single scattering, the extinction of the atmospheric medium, and the reflection albedo of the ground surface by generating random numbers to decide scattering sites and scattering (or reflection) angles from probability density functions. A three dimensional Monte Carlo code was developed which can calculate each component of the upward radiance. The adjacency effect on the total upward radiance was quantitatively evaluated, by this Monte Carlo analysis, and it was found that it is significant in the case of the ground with high albedo value. This indicated that the correction of the adjacency effect on the rugged terrain image data is necessary if the ground is covered with either snow or vegetation (in the near infrared). I.E.

A92-35516

METHOD TO SUBTRACT AN EFFECT OF THE GEOCORONA EUV RADIATION FROM THE LOW ENERGY PARTICLE (LEP) DATA BY THE AKEBONO (EXOS-D) SATELLITE

T. HIGUCHI (Institute of Statistical Mathematics, Tokyo, Japan) *Journal of Geomagnetism and Geoelectricity* (ISSN 0022-1392), vol. 43, no. 12, 1991, p. 957-978. refs
(Contract MOESC-02740218)
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Data obtained from the Low Energy Particle spectra analyzer aboard the Japanese satellite EXOS-D (renamed Akebono after launch) were found to contain noise due to the geocorona EUV radiation. An efficient procedure for eliminating this background noise, based on a Bayesian smoothness approach, is described. Using this method, the background noise component is easily realized as a fixed-interval smoothed value by using the recursive Kalman filter and smoother algorithm. I.S.

A92-35533

SEISMOLOGICAL EVIDENCE FOR METASTABLE OLIVINE INSIDE A SUBDUCTING SLAB

TAKASHI IIDAKA and DAISUKE SUETSUGU (Tokyo, University, Japan) *Nature* (ISSN 0028-0836), vol. 356, no. 6370, April 16, 1992, p. 593-595. Research supported by MOESC. refs
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Time-travel residuals from deep earthquakes recorded by the dense seismograph network in Japan are used here to investigate the configuration of the olivine-spinel phase boundary inside the subducting Pacific plate. Theoretical travel-time residuals for the equilibrium model do not fit the observed residuals, whereas those for the metastable model do, implying the presence of metastable olivine inside the subducting slab. C.D.

A92-36318

NOBLE GASES IN SUBMARINE GLASSES FROM MID-OCEANIC RIDGES AND LOIHI SEAMOUNT - CONSTRAINTS ON THE EARLY HISTORY OF THE EARTH

H. HIYAGON (Tokyo, University, Japan), M. OZIMA (Osaka University, Toyonaka, Japan), B. MARTY (Paris VI, Université, France), S. ZASHU (Tokyo, University, Japan), and H. SAKAI (Yamagata University, Japan) *Geochimica et Cosmochimica Acta* (ISSN 0016-7037), vol. 56, no. 3, March 1992, p. 1301-1316. refs
(Contract MOESC-62611513)
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Noble gas compositions in submarine glasses from midoceanic

ridges and from Loihi seamount were analyzed. Rather uniform He-3/He-4 ratios and Ar-40/Ar-36 ratios varying from nearly the atmospheric ratio to 15,200 were found in MORB samples along with positively correlated anomalies of excess Xe-129 and fissionogenic xenon. Isotopic anomalies of neon, including high Ne-20/Ne-22 ratios of up to about 13 and high Ne-21/Ne-22 of up to about 0.06 were observed in MORB samples. The latter ratio can be explained by nuclear reactions operating in the mantle while the former cannot. High Ne-20/Ne-22 ratio of up to 11.74 and slightly high Ne-21/Ne-22 ratio of up to 0.034 were found in some Loihi samples. These findings strongly suggest the existence of a solar-type neon in the whole mantle and that neon isotopic composition in the present atmosphere and the mantle differ from each other. This appears to contradict the prevailing idea that the present atmosphere was simply derived from the solid earth after its formation. C.D.

A92-37129

PERIODIC HOTSPOT DISTRIBUTION AND SMALL-SCALE CONVECTION IN THE UPPER MANTLE

ATSUSHI YAMAJI (Tohoku University, Sendai, Japan) *Earth and Planetary Science Letters* (ISSN 0012-821X), vol. 109, no. 1-2, March 1992, p. 107-116. refs
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Hotspots are commonly attributed to mantle plumes and to a first order, the hotspot distribution is correlated with long-wavelength geoid anomalies and with higher temperatures in the lower mantle, suggesting that the plumes are generated in the lower mantle. It is shown that the second-order distribution is periodic with a typical spacing of 800-1000 km. Such a spacing would be too narrow for plumes to ascend directly from the lower mantle, but is close to the thickness of the upper mantle. The alignment of convection cells in the upper mantle seems to control the periodicity. To reconcile the first- and second-order distributions, assuming limited mass fluxes across the 670-km boundary, a lateral deflection of plumes as they breach the transition zone from below is required. Author

A92-37830

THE RUPTURE PROCESS OF THE 1989 OFFSHORE ITO EARTHQUAKES PRECEDING A SUBMARINE VOLCANIC ERUPTION

MINORU TAKEO (Tokyo, University, Japan) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. B5, May 10, 1992, p. 6613-6627. refs
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A novel inversion method for deriving the source time function of the rupture process of the 1989 offshore Ito earthquakes is presented. The parameters, which are the values and first derivatives at knots of the spline function, are determined by minimizing a squared error between the observed and synthetic seismographs. Some numerical experiments (simulations) are carried out on near-field seismic records in order to demonstrate this method's performance. C.A.B.

A92-37859

GRAVITY AND POTENTIAL CHANGES DUE TO SHEAR AND TENSILE FAULTS IN HALF-SPACE

SHUHEI OKUBO (Tokyo, University, Japan) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. B5, May 10, 1992, p. 7137-7144. refs
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Expressions of potential and gravity changes caused by faulting on a finite rectangular plane buried in a homogenous half-space are presented. The expressions can be used to evaluate coseismic changes in surface gravity and geoid height. Observed gravimetric data combined with the present formulas thus provide constraints on the fault geometry and magnitudes of dislocation. Author

A92-37879

CRUSTAL TILTING DERIVED FROM HOLOCENE SEA-LEVEL OBSERVATIONS ALONG THE EAST COAST OF HOKKAIDO IN JAPAN AND UPPER MANTLE RHEOLOGY

Y. MAEDA (Yamagata University, Japan), M. NAKADA (Kumamoto University, Japan), E. MATSUMOTO (Nagoya University, Japan), and I. MATSUDA (Shiretoko Museum, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, no. 9, May 4, 1992, p. 857-860. refs
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A92-37883

RISING SLOPE OF MOMENT RATE FUNCTIONS - THE 1989 EARTHQUAKES OFF EAST COAST OF HONSHU

YASUSHI ISHIHARA (Yokohama City University, Kanazawa, Japan), YOSHIO FUKAO, ISAO YAMADA, and HARUMI AOKI (Nagoya University, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, no. 9, May 4, 1992, p. 873-876. refs
(Contract MOESC-63420013)
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The mechanisms of a series of large earthquakes are studied for the foreshock, the mainshock and the two aftershocks utilizing the STS-1 broadband records at station INU approximately 700 km from the epicenters. The lowpass filtered seismograms of these earthquakes demonstrate mutually similar waveforms, in good agreement with those calculated for a known mechanism by an extended reflectivity technique. R.E.P.

A92-37907

SEARCH FOR LOWER MANTLE HIGH-VELOCITY ZONES BENEATH THE DEEPEST KURIL AND MARIANA EARTHQUAKES

KENTA OKANO and DAISUKE SUETSUGU (Tokyo, University, Japan) *Geophysical Research Letters* (ISSN 0094-8276), vol. 19, no. 8, April 24, 1992, p. 745-748. Research supported by MOESC. refs
Copyright

Travel time analyses are performed for the Kuril and the Mariana subduction zones to investigate whether a lower mantle high-velocity zone exists immediately beneath the deepest earthquakes in these regions. The corrected residuals for the deep Kuril events show that a high velocity zone extends in the down-dip direction of the Kuril slab in the lower mantle. On the other hand, the residuals for the deep Mariana events show no evidence for a high-velocity zone in the down-dip direction beneath the deepest earthquakes. A reasonable interpretation of these results is that the Kuril slab penetrates into the lower mantle (h is not less than 670 km) but that the Mariana slab does not extend vertically into the lower mantle. Author

A92-38144

DRIFTS OF AURORAL STRUCTURES AND THEIR RELATIONSHIP TO GEOMAGNETIC ACTIVITY

RUMI NAKAMURA and TAKASI OGUTI (Tokyo, University, Japan) *IN: Proceedings of the NIPR symposium on Upper Atmosphere Physics*, no. 2. Tokyo, National Institute of Polar Research, 1989, p. 96-102. refs
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The paper investigates the accurate motion of some auroral structures, such as pulsating and nonpulsating patches and discrete auroral arc fragments, on the basis of all-sky TV observations of auroras. It is shown that the general drift pattern of these auroral structures correspond, on a gross scale, to magnetospheric convection, namely, westward in the evening sector and eastward in the morning sector. The drift velocity ranges from 50 to 2000 m/s, corresponding to an electric field intensity from 3 to 120 mV/m at the ionospheric level and from 0.1 to 4 mV/m in the magnetospheric equatorial region at an L value of about 6.5. Temporal and spatial changes in the drift of the patches are related to the evolution of a substorm. Clear enhancement in the drift velocity associated with increases in the westward electrojet is observed at a different local time region from the center of the electrojet. It is concluded that the convection electric field changes temporally and spatially when a new substorm expansion of aurora occurs in the midnight sector. P.D.

46 GEOPHYSICS

A92-40196

CHARACTERISTICS OF NARROW BAND MID-LATITUDE HISS OBSERVED IN THE TOPSIDE IONOSPHERE

TADANORI ONDOH (Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 319-334. refs

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Frequency-time spectra are presented of four examples of typical midlatitude hiss found in ISIS VLF electric field data (50 Hz-30 kHz) received at Syowa Station, Antarctica under geomagnetically quiet and moderate conditions. Latitudinal and local time distributions are also presented of the occurrence rates of midlatitude hiss during geomagnetically quiet and moderate ($K_p=0-3$) and disturbed ($K_p=4-6$) periods. The data were obtained statistically from 507 satellite passes between December 1976 and January 1983. The peak occurrence rate of midlatitude hiss at invariant latitude 60 deg (plasma-pause latitude) and that in the late evening sector suggest that the narrowband midlatitude hiss is caused by the cyclotron resonance instability of energetic electrons which are injected from the magnetotail and drift eastward around the plasma-pause. S.A.V.

A92-41696

DYNAMIC RUPTURE PROCESSES OF INLAND EARTHQUAKES IN JAPAN WEAK AND STRONG ASPERITIES

TAKASHI MIYATAKE (Tokyo, University, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 10, May 22, 1992, p. 1041-1044. refs

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A92-41888

ANNUAL, QUASI-BIENNIAL, AND EL NINO-SOUTHERN OSCILLATION (ENSO) TIME-SCALE VARIATIONS IN EQUATORIAL TOTAL OZONE

MASATO SHIOTANI (Kyoto University, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. D7, May 20, 1992, p. 7625-7633. Research supported by MOESC and Institute of Space and Astronautical Science. refs

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A92-41996

PATTERN OF ELECTRON AND ION PRECIPITATION IN NORTHERN AND SOUTHERN POLAR REGIONS FOR NORTHWARD INTERPLANETARY MAGNETIC FIELD CONDITIONS

O. A. TROSHICHEV and A. NISHIDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A6, June 1, 1992, p. 8337-8354. refs

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The patterns of electron and ion precipitation in the polar cap and the auroral zone for northward IMF conditions are investigated using data from the DMSP F6 and F7 satellites. Results show that, in the auroral oval, the ion precipitation is smooth and the ratio of the total electron flux to the total ion flux is less than 20. On the other hand, the polar cap ion precipitation is patchy, and the ratio is more than 20. The boundary between the two types of ion precipitation is defined by a sharp fall of the ion total number flux below the level 5×10^5 to 10^6 ions/sq cm per sr. The electron precipitation in the polar cap bounded by this boundary occurs in four patterns, two of which are symmetric and two asymmetric. I.S.

A92-43050

ATMOSPHERIC EFFECT ON THE UPWELLING RADIATION AT THE TOP OF THE ATMOSPHERE OVER A STREAM

T. TAKASHIMA and K. MASUDA (Meteorological Research Institute, Tsukuba, Japan) Earth, Moon, and Planets (ISSN 0167-9295), vol. 57, no. 1, April 1992, p. 75-84. refs

Copyright

The atmospheric effect on the upwelling radiation at the top of the atmosphere over a stream is investigated using the Takashima and Masuda (1992) approach, where the atmosphere

is bounded by two half Lambert surfaces and by the stream inserted between them. In the computations, the probability of radiation interacting with the respective half surfaces and the stream is calculated based on the assumption of single scattering in the atmosphere. The results of numerical simulation indicate that the surroundings have a significant effect on the radiation from the stream. I.S.

A92-43441

A LONG-TERM GEOMAGNETIC EXCURSION FROM PLIO-PLEISTOCENE SEDIMENTS IN JAVA

MASAYUKI HYODO (Kobe University, Japan), WAHYU SUNATA, and EKO E. SUSANTO (Geological Research and Development Centre, Bandung, Indonesia) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. B6, June 10, 1992, p. 9323-9335. Research supported by Geological Research and Development Centre of Indonesia and Japan International Cooperation Agency. refs

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Duplicate records of a geomagnetic excursion at two sites separated by 200 km in Java, Indonesia, are reported. The existence of a large-scale wing of declination between the Olduvai and Jaramillo event is revealed. The field directions in reverse polarity show a gradual clockwise swing to almost west-pointing directions, followed by a rapid return to south-pointing directions. At both sites, the declinations have maximum deflection more than 70 deg from the axial dipole field direction, and the inclinations remain low during the swing. An upward-pointing eccentric radial dipole model rather than a downward-pointing one seems plausible to explain the geomagnetic behavior during the excursion. P.D.

A92-43563

A MORPHOLOGICAL STUDY ON MID-LATITUDE E-REGION FIELD-ALIGNED IRREGULARITIES OBSERVED WITH THE MU RADAR

MAMORU YAMAMOTO, SHOICHIRO FUKAO (Kyoto University, Uji, Japan), TADAHIKO OGAWA (Communications Research Laboratory, Nakaminato, Japan), TOSHITAKA TSUDA, and SUSUMU KATO (Kyoto University, Uji, Japan) (E-region irregularities; Selected Papers from the 23rd URSI General Assembly, Prague, Czechoslovakia, Aug. 28-Sept. 5, 1990. A92-43551 18-46) Journal of Atmospheric and Terrestrial Physics (ISSN 0021-9169), vol. 54, no. 6, June 1992, p. 769-777. refs

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A92-44301

FORMATION OF MULTIPLE TROPOPAUSE AND STRATOSPHERIC INERTIO-GRAVITY WAVES

MANABU D. YAMANAKA (Kyoto University, Uji, Japan) (The earth's middle and upper atmosphere; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C6, C7, C9, C10 and C11/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-44276 18-46) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 10, Oct. 1992, p. 181-190. refs

(Contract MOESC-02854037)

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Lower-stratospheric layered structures of a few kilometers in thickness observed mainly by rawinsondes and MST radars are reviewed. Multiple tropopauses significant levels are found in the data of rawinsonde observations, whereas wind fluctuations associated with quasi-monochromatic internal inertio-gravity waves are analyzed from the MST radar observations. These two features are identified by several case studies, and a preliminary theoretical approach to explain the origin and role of them is presented. A poleward flow is induced and maintained by this structure, which is considered to compensate a vertical velocity field induced by an imbalance of the radiative-convective equilibrium in the troposphere. Author

A92-44306

A PARAMETERIZATION OF VERTICAL EDDY DIFFUSIVITY BY USING 'QUASI-MONOCROMATIC' GRAVITY-WAVE FIELD HYPOTHESIS

MANABU D. YAMANAKA (Kyoto University, Uji, Japan) (The earth's middle and upper atmosphere; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C6, C7, C9, C10 and C11/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-44276 18-46) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 10, Oct. 1992, p. 215-218. refs
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A92-44713

TWO-DIMENSIONAL INTERACTION BETWEEN A PLANE HYDROMAGNETIC WAVE AND THE EARTH-IONOSPHERE SYSTEM WITH CURVATURE

H. OHNISHI and T. ARAKI (Kyoto University, Japan) Annales Geophysicae (ISSN 0992-7689), vol. 10, no. 5, May 1992, p. 281-287. refs
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In order to understand a disturbance field caused by a fast mode hydromagnetic wave (HM) during geomagnetic sudden commencements this paper examines the interaction of a plane HM wave propagated earthward from the noon magnetopause in the equatorial plane of the magnetosphere with a system composed of a conducting cylindrical earth and ionosphere. The magnetic fields above and below the ionosphere and the electric current and charge in the ionosphere are calculated at several local times. The ionospheric current is generally westward but a weak eastward current flows in the beginning stage of the rise of the incident magnetic field in the nighttime. The magnetic field is enhanced above the ionosphere and the enhancement rate is largest at noon. The magnetic field increase on the ground begins almost simultaneously, with nearly the same waveform and amplitude at any local time. Author

A92-47466

KELVIN-HELMHOLTZ INSTABILITY AT THE MAGNETOSPHERIC BOUNDARY - DEPENDENCE ON THE MAGNETOSHEATH SONIC MACH NUMBER

AKIRA MIURA (Tokyo, University, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A7, July 1, 1992, p. 10,655-10,675. Research supported by Yamada Science Foundation. refs
(Contract MOESC-63740229; MOESC-03640390)
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The study investigates the dependence of the Kelvin-Helmholtz (K-H) instability at the magnetospheric boundary on the magnetosheath sonic Mach number of the local time, and evaluates quantitatively the importance of the instability in the viscous interaction and in a ULF wave generation. It is shown that for all sonic Mach numbers a velocity boundary layer (VBL) is formed inside the magnetopause owing to the momentum transport by the K-H instability, and it becomes wider for a smaller sonic Mach number. A flow vortex is excited at the inner edge of the VBL for all sonic Mach numbers, and the magnetopause boundary is more highly nonlinearly corrugated by the instability for a smaller sonic Mach number. For the supersonic magnetosheath convective Mach number the total pressure perturbation in the magnetosheath becomes oscillatory in the x direction, while in the magnetosphere it is evanescent because the magnetospheric convective Mach number remains less than 1.0. P.D.

A92-47467* National Aeronautics and Space Administration, Washington, DC.

SURVEY OF TRANSIENT MAGNETIC FIELD EVENTS IN THE DAYSIDE MAGNETOSPHERE

H. KAWANO, S. KOKUBUN (Tokyo, University, Japan), and K. TAKAHASHI (Johns Hopkins University, Laurel, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A7, July 1, 1992, p. 10,677-10,692. Research supported by NASA. refs

(Contract MOESC-62420013; NSF ATM-91-11991; N00039-89-C-5301)

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Data acquired with AMPTE/CCE are employed to investigate transient magnetic field events (TMFEs) in the dayside magnetosphere. TMFEs are found to occur more frequently near the magnetopause than deep in the magnetosphere, and the amplitude of a TMFE increases as the spacecraft comes closer to the magnetopause. It is inferred that they are generated at the magnetopause. From the MLT dependence of the rotational polarity of the transverse magnetic field perturbation, it is suggested that TMFE structures move longitudinally away from the noon meridian. Latitudinal motion away from the equator is also inferred from the latitudinal dependence of the occurrence rates of the standard and reverse events. The motion of TMFEs is tailward in both azimuthal and north-south directions. It is suggested that TMFEs carry oppositely directed twin field-aligned currents, separated in the direction perpendicular to the direction of motion and having the same current intensity. P.D.

A92-47468* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.

EXCITATION OF PC 5 PULSATIONS IN THE MORNING SECTOR BY A LOCAL INJECTION OF PARTICLES IN THE MAGNETOSPHERE

O. SAKA (Kyushu University, Fukuoka, Japan), T. IJIMA (Tokyo, University, Japan), H. YAMAGISHI, N. SATO (National Institute of Polar Research, Tokyo, Japan), and D. N. BAKER (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A7, July 1, 1992, p. 10,693-10,701. refs

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A characteristic of Pc 5 pulsation in the morning sector is determined by use of ground magnetometer and riometer data, in conjunction with data acquired with satellites which include the magnetic fields above the ionosphere and electron fluxes at geosynchronous orbit. It is found that the onset of a flux increase in energetic electrons of 30 keV to 200 keV at geosynchronous orbit almost coincides with the onset of Pc 5 pulsation activity and riometer absorption on the ground. It is confirmed when the Pc 5 pulsation occurs on the ground, the large-scale Birkeland current system observed at ionospheric altitude splits into a number of small-scale Birkeland current pairs. It is inferred that the electron flux enhancement, presumably supplied from the tail plasma sheet associated with the substorm onset, provides stress to cause the background large-scale plasma vortex to split into the small-scale vortices. It is suggested that the field-aligned currents in the small-scale vortices propagate along the field lines and sustain the standing Alfvénic oscillations at several different, but neighboring shells of the field lines. Author

A92-47469

FIELD-ALIGNED CURRENT SIGNATURES DURING THE MARCH 13-14, 1989, GREAT MAGNETIC STORM

R. FUJII (National Institute of Polar Research, Itabashi; Nagoya University, Japan), H. FUKUNISHI (Tohoku University, Sendai, Japan), S. KOKUBUN (Tokyo, University, Japan), M. SUGIURA (Tokai University, Tokyo, Japan), F. TOHYAMA (Tokai University, Kanagawa, Japan), H. HAYAKAWA, K. TSURUDA (Institute of Space and Astronautical Science, Sagami, Japan), and T. OKADA (Toyama Prefectural University, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A7, July 1, 1992, p. 10,703-10,715. refs

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A92-47618

LINE-BY-LINE COMPUTATION OF THE ATMOSPHERIC ABSORPTION SPECTRUM USING THE DECOMPOSED VOIGT LINE SHAPE

AKIHIRO UCHIYAMA (Meteorological Research Institute, Tsukuba, Japan) Journal of Quantitative Spectroscopy & Radiative Transfer (ISSN 0022-4073), vol. 47, no. 6, June 1992, p. 521-532. refs
Copyright

46 GEOPHYSICS

A new line-by-line method has been developed to calculate the spectral absorption coefficients of absorption lines with a Voigt line shape in the terrestrial atmosphere. In the method, the Voigt line shape is decomposed into several subfunctions, with even quadratic functions used as subfunctions. This functional form allows for easy estimation of the half-width of the subfunction. The final spectral absorption is obtained by the superposition of independent spectral absorption coefficients. The finer details of the absorption spectrum have then been examined to determine if they are zero or not at every grid point. This procedure eliminates the need for unnecessary calculations in interpolations of absorption coefficients from coarser to finer resolution and also saves storage capacity. Author

A92-47705

STRATOSPHERIC OZONE PROFILES BASED ON THE EXOS-C SATELLITE DATA

T. OGAWA (Tokyo, University, Japan), M. KOIKE (Nagoya University, Toyokawa, Japan), and K. SUZUKI (Yokohama National University, Japan) (Middle and upper atmosphere results; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C2 and C3/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-47701 20-46) *Advances in Space Research* (ISSN 0273-1177), vol. 13, no. 1, Jan. 1993, p. 55-58. refs
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Monthly and zonal average distributions of ozone in a meridional plane were obtained using the UV spectrometer data on the EXOS-C satellite during March 1984 - September 1987. Individual vertical ozone profiles retrieved from the measured spectral intensities of the backscattered UV was proved to be in general agreement within ± 10 percent with those from ground-based measurements. The EXOS-C meridional ozone distributions are constructed and compared with those of the CIRA model to exhibit an agreement within ± 10 percent on the average in the atmospheric pressure range of 15 - 1.5 mb (altitudes between about 28 km and about 45 km). At altitudes above about 50 km, the EXOS-C ozone volume mixing ratios are systematically smaller than those of the CIRA. This difference can be attributed to a calibration bias. Amplitudes of seasonal variations in ozone volume mixing ratios are also obtained at various latitudes and atmospheric pressure levels and compared with those of the CIRA. Author

A92-47711

NITRIC OXIDE VARIABILITY IN THE LOWER THERMOSPHERE AT LOW LATITUDES

N. IWAGAMI, K. KITA, T. OGAWA (Tokyo, University, Japan), and K. S. ZALPURI (National Physical Laboratory, New Delhi, India) (Middle and upper atmosphere results; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C2 and C3/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-47701 20-46) *Advances in Space Research* (ISSN 0273-1177), vol. 13, no. 1, Jan. 1993, p. 131-134. refs
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Nitric oxide in the lower thermosphere has been measured by means of the NO gamma band day airglow. A UV photometer with NO gas cells is used for correlation spectroscopy to discriminate the NO day airglow from the continuum due to the Rayleigh scattering of solar UV. Using this instrument, rocket observations at Uchinoura (31 deg N) around sunset obtained 5 profiles of NO height distribution at different phases of solar activity. Maximum density of NO occurring at a height of 105-110 km exhibits a variation of factor 8 as F10.7 varies from 71 to 259 units. Two rocket observations made at Thumba (9 deg N) after sunrise using the same technique showed a similar variation due to solar activity for F10.7 = 73 to 116 unities. The relative amplitude of the NO variation due to solar activity is consistent with those from the SME satellite observations, although there is a systematic discrepancy in the absolute NO densities between these data sets. Author

A92-47723

ENERGETICS IN THE PLASMA BUBBLE

K.-I. OYAMA (Institute of Space and Astronautical Science, Sagami-hara, Japan), S. WATANABE (National Research Council of Canada, Herzberg Institute of Astrophysics, Ottawa), and H. OYA (Tohoku University, Sendai, Japan) (Middle and upper atmosphere results; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission C /Meetings C2 and C3/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-47701 20-46) *Advances in Space Research* (ISSN 0273-1177), vol. 13, no. 1, Jan. 1993, p. 293-297. refs
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Energy budget in the plasma bubble is discussed in order to explain the electron temperatures observed at a height of 600 km. From calculations it has been shown that the electron temperature profile inside plasma bubble can be basically explained as a function of energy input to the plasma bubble, the ion temperature and the electron density. These calculations are found to be consistent with the present satellite observations. Possible mechanisms by which energy injections in the plasma bubble take place under different conditions are suggested. Author

A92-47953

GMS-4 OBSERVATIONS OF VOLCANIC ERUPTION CLOUDS FROM MT. PINATUBO, PHILIPPINES

MASAMI TOKUNO (Meteorological Satellite Center, Kiyose, Japan) Meteorological Satellite Center, Technical Note (ISSN 0388-9653), no. 23, Nov. 1991, p. 1-14. refs

Studies are presented of IR and visible imageries of the gigantic volcanic eruption clouds (VECs) from Mt. Pinatubo taken on June 15, 1991 at one hour intervals by the geostationary meteorological satellite. A huge disk-shaped VEC showing a 'wave' texture appeared in the 0640 UT visible image covering an area 300 km in diameter. R.E.P.

A92-48360

DEGREE OF MELTING AND SOURCE COMPOSITION OF CENOZOIC BASALTS IN SOUTHWEST JAPAN - EVIDENCE FOR MANTLE UPWELLING BY FLUX MELTING

HIKARU IWAMORI (Tokyo, University, Japan) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. B7, July 10, 1992, p. 10,983-10,995. Research supported by Japan Society for the Promotion of Science. refs
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A92-48370

INTERSEISMIC DEFORMATION AT THE NANKAI TROUGH, JAPAN, SUBDUCTION ZONE

J. C. SAVAGE and W. THATCHER (USGS, Menlo Park, CA) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. B7, July 10, 1992, p. 11,117-11,135. refs

Tide-gage records from the past three decades are studied to determine the uplift on the southwestern coast of Japan generated by the earthquakes in 1944 and 1946. The temporal dependence of the uplift rates at each site is expressed by the superposition of an exponentially decaying transient in the postseismic and interseismic rates. The steady uplift rate determined in the analysis is shown to confirm the results of a dislocation model of subduction, although some doubts are cast on the theory that steady interseismic uplift rates follow the first decade postseismic. C.C.S.

A92-51194

BY-CONTROLLED FIELD-ALIGNED CURRENTS NEAR MIDNIGHT AURORAL OVAL DURING NORTHWARD INTERPLANETARY MAGNETIC FIELD

SATOSHI TAGUCHI (Kyoto University, Japan) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. A8, Aug. 1, 1992, p. 12,231-12,243. refs
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A new By-controlled field-aligned current system which develops in the midnight sector is presented on the basis of the magnetic

field data from southern passes of Magsat for which the IMF Bz component was positive and the By component was particularly stable. The current system, referred to as the midnight sector triple-sheet (MTS) field-aligned current system, appears in the premidnight sector (postmidnight sector) of the southern hemisphere when By is negative (positive). When By is negative (positive), the current system consists of the most equatorward and the most poleward sheets with currents flowing away from (into) the ionosphere and a sheet in between with currents flowing into (away from) the ionosphere. The MTS current system is defined in 70 passes among 100 passes for which IMF Bz was positive and By was stable. Magnitude of By and the magnetic local time are found to be the main controlling factors of the intensity of the MTS current system. C.A.B.

A92-52197 Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CRUSTAL DEFORMATION MEASUREMENTS IN CENTRAL JAPAN DETERMINED BY A GLOBAL POSITIONING SYSTEM FIXED-POINT NETWORK

SEIICHI SHIMADA (National Research Institute for Earth Science and Disaster Prevention, Tsukuba, Japan) and YEHUDA BOCK (Scripps Institution of Oceanography, La Jolla; JPL, Pasadena, CA) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. B9, Aug. 10, 1992, p. 12,437-12,455. refs (Contract USGS-14-08-0001-G1673; NAGW-2133; NAGW-2641) Copyright

Results are presented from temporally dense measurements of crustal deformation associated with the convergence of the Eurasian (EUR), Pacific, North American, and Philippine Sea (PHS) plates, carried out in April 1988 by a 10-station GPS fixed-point network established in central Japan. Using regional orbit relaxation methods, the analysis of the first 17-month data revealed significant horizontal deformation across the Suruga trough. Namely, it was found that a site in the northern tip of PHS plate moved nearly westward with a velocity of 28 ± 5 mm per year, and a site at the southeastern tip of EUR plate moved south-southwestward with a velocity of 18 ± 5 mm per year. A significant vertical uplift with a velocity of 20 mm/yr was detected at a site inland of the Tokai district located in the Akaishi uplift zone and at a site on the Hatsushima Island in Sagami Bay. I.S.

A92-52289

PRECURSORY AND COSEISMIC ANOMALIES IN WELL WATER LEVELS OBSERVED FOR THE FEBRUARY 2, 1992 TOKYO BAY EARTHQUAKE

GEORGE IGARASHI, HIROSHI WAKITA, and TSUTOMU SATO (Tokyo, University, Japan) *Geophysical Research Letters* (ISSN 0094-8534), vol. 19, no. 15, Aug. 3, 1992, p. 1583-1586. refs Copyright

A92-52296

LINE-TYING EFFECTS IN THE KELVIN-HELMHOLTZ INSTABILITY

AKIRA MIURA (Tokyo, University, Japan) and J. R. KAN (Alaska, University, Fairbanks) *Geophysical Research Letters* (ISSN 0094-8534), vol. 19, no. 15, Aug. 3, 1992, p. 1611-1614. Research supported by Toray Science Foundation and Yamada Science Foundation. refs (Contract MOESC-63740229; MOESC-0364039; NSF ATM-85-21194) Copyright

Results of a three-dimensional linear analysis of the magnetohydrodynamic Kelvin-Helmholtz instability in the magnetosphere-ionosphere coupled system are reported. The results demonstrate the stabilizing influence of the ionospheric line-tying on the Kelvin-Helmholtz instability. However, the ionospheric stabilization can be insignificant when the eigenmode of the flow perturbation has nodes in the ionospheric boundaries. V.L.

A92-53435

LONGITUDINALLY DIFFERENT VARIATIONS OF LOWER TROPOSPHERIC CARBON DIOXIDE CONCENTRATIONS OVER THE NORTH PACIFIC OCEAN

TAKAKIYO NAKAZAWA, SHOHEI MURAYAMA, KOHJI MIYASHITA, SHUJI AOKI, and MASAYUKI TANAKA (Tohoku University, Sendai, Japan) *Tellus, Series B - Chemical and Physical Meteorology* (ISSN 0280-6509), vol. 44B, no. 3, July 1992, p. 161-172. refs

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To elucidate temporal and spatial variations of the atmospheric CO₂ concentration over the north Pacific Ocean, air samples have been collected systematically using four container ships for three years from 1984 to 1986. The seasonal CO₂ cycle was most enhanced at high latitudes and decreased gradually going southward with a phase delay. North of 30 deg N, the seasonal amplitude was larger in the western part than in the eastern part; however, to the south, the situation was reversed. The southward phase shift of the seasonal CO₂ cycle was much reduced in the eastern part, as compared with that in the western part. In the western part, the annual mean values of the CO₂ concentration in respective years were high at middle latitudes and decreased going southward and northward; those in the eastern part were rather constant at middle and high latitudes, but increased slightly with decreasing latitude. As a result, yearly mean CO₂ concentrations between 50 deg and 25 deg N were always higher in the western part than in the eastern part and those at lower latitudes showed the opposite distribution. Differences of the CO₂ concentration between the eastern and western parts depended on season and latitude. Author

A92-53676

BALLOON-BORNE MEASUREMENT OF DIURNAL VARIATION OF NITRIC OXIDE AT 26 KM

Y. KONDO, A. IWATA, M. KOIKE (Nagoya University, Toyokawa, Japan), M. PIRRE (CNRS, Laboratoire de Physique et Chimie de l'Environnement, Orleans, France), N. YAJIMA, and J. NISHIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: *International Symposium on Space Technology and Science*, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1613-1617. Research supported by Chinese Academy of Sciences. refs Copyright

A chemiluminescent NO detector was launched from Uchinoura, Japan at 00:30 JST on July 29, 1987. The balloon reached a float altitude of 26 km at around 02:00 JST and stayed at this altitude until 16:00 JST when it started a slow descent. Near local sunrise, when the solar zenith angle reached 92.7 deg, the NO concentration started to increase rapidly. This rapid increase continued for about 30 minutes. The NO concentration continued to increase, albeit more slowly, for a further 7 to 8 hours, and then became stable. The NO diurnal variation is calculated by a time-dependent photochemical model assuming a 14 ppbv total odd nitrogen concentration, constrained by ozone and temperature measured simultaneously with NO; the result agrees quite well with the observed temporal NO variation. Author

A92-53720

PLASMA WAVE PHENOMENA OBSERVED BY DE-1 IN LOW-DENSITY MAGNETOSPHERE

TADANORI ONDOH, YOSHIKATSU NAKAMURA, SHIGEAKI WATANABE, and MASAKI SATO (Communications Research Laboratory, Koganei, Japan) IN: *International Symposium on Space Technology and Science*, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1917-1922. refs

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Wide-band electric field data (650 Hz-40 kHz) from (DE-1) of high altitude polar orbiter have been received at Kashima, Japan, since July, 1986. Also, since August 1989, unmanned automatic remote control of the 11-m antenna at Kashima has been conducted from Tokyo, about 100 km west of Kashima, to receive the DE-1 plasma wave data by personal computer communication

through 7.5 GHz special telephone line between the two places. Impulsive VLF waves (1-9 kHz) with duration less than 100 msec were observed at geocentric distances from 3.1 to 4.9 Re (earth's radii) in the low-latitude magnetosphere of low electron density (below 5/cu cm). The impulsive VLF waves occurred always in association with strong narrow-band 1 kHz hiss in geomagnetic quiet and disturbed periods. Generation of the impulsive VLF waves is discussed in terms of Landau resonant trapping of magnetospheric electrons by the strong ELF hiss propagating along geomagnetic field lines. Other VLF wave phenomena with impulsive structures are also discussed. Author

A92-53721**A FEASIBILITY STUDY OF MAGNETOSPHERE IMAGING**

KOICHIRO TSURUDA (Institute of Space and Astronautical Science, Sagamihara, Japan), TOSHIHIRO OGAWA (Tokyo, University, Japan), and TOMOKO NAKAGAWA (Institute of Space and Astronautical Science, Sagamihara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1923-1927. refs

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The feasibility of imaging the magnetosphere using resonant scattering of the sunlight by magnetospheric O(+) and H(e) is investigated. The number of photons that are scattered by the magnetospheric ions is calculated and compared with that from interplanetary ions by using simple models for ion distributions in earth's magnetosphere and in interplanetary space. A telescope with 30 x 30 pixels each of which collects light from 1 deg x 1 deg with a 1 cm x 1 cm area and an efficiency of 1 percent is expected to obtain sufficient number of photons from the magnetospheric ions in 15 minutes with a good S/N ratio.

Author

A92-54618**A POSSIBLE FORESHOCK OF A FUTURE LARGE EARTHQUAKE NEAR ODAWARA, CENTER JAPAN**

MIZUHO ISHIDA (National Research Institute for Earth Science and Disaster Prevention, Tsukuba, Japan) and MASAYUKI KIKUCHI (Yokohama City University, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 16, Aug. 21, 1992, p. 1695-1698. refs

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A92-54620**SEGREGATION OF HIGH PRESSURE PARTIAL MELTS FROM PERIDOTITE USING AGGREGATES OF DIAMOND - A NEW EXPERIMENTAL APPROACH**

KEVIN T. M. JOHNSON and IKUO KUSHIRO (Tokyo, University, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 16, Aug. 21, 1992, p. 1703-1706. Research supported by Japan Society for the Promotion of Science and NSF. refs

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A new experimental technique is reported that achieves segregation of small percentages of melt from a peridotite source using a porous layer of diamond chips adjacent to the peridotite. With this configuration, experiments were conducted using piston-cylinder apparatus at 15 kb and 1425 C over a range of times. Melts produced by this method do not suffer from crystal growth in the melt upon quenching and, since they are direct products of melting of the peridotite source, do not contain introduced basaltic components as in sandwich techniques. It is shown that while melts produced in short duration runs are not in equilibrium with the residue, equilibrium is approached in the longer duration runs. This new technique may be adapted to address questions of melt generation in the mantle. Author

A92-54623**GEOMAGNETIC POLES OVER THE PAST 10,000 YEARS**

MASO OHNO and YOZO HAMANO (Tokyo, University, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 16, Aug. 21, 1992, p. 1715-1718. refs

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Locations of the geomagnetic pole over the past 10,000 years have been calculated by averaging the VGP positions obtained from paleomagnetic data. The distribution of the geomagnetic pole was elongated to the direction parallel to the meridian of 45 deg and 225 deg longitude, and westward movement of the pole was predominant throughout this period. The time sequence of the polar motion can be divided into three intervals, the intervals between ca. 10,000 B.P. and ca. 7000 B.P., between ca. 7000 B.P. and ca. 3700 B.P., and between ca. 3700 B.P. and the present. During the period between ca. 7000 and ca. 3700 B.P., the range of the movement of the geomagnetic pole was limited within 5 degrees around the geographical pole. Before and after this period, the movement was very active, fluctuating over 10 degrees. The results of the last 2000 years show good consistency with the geomagnetic pole calculated from archaeomagnetic data by Merrill and McElhinny (1983). Author

A92-54646*

National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

REACTIVE NITROGEN, OZONE, AND NITRATE AEROSOLS OBSERVED IN THE ARCTIC STRATOSPHERE IN JANUARY 1990

Y. KONDO (Nagoya University, Toyokawa, Japan), P. AIMEDIEU (CNRS, Service d'Aeronomie, Verrieres-le-Buisson, France), M. KOIKE, Y. IWASAKA (Nagoya University, Toyokawa, Japan), P. A. NEWMAN (NASA, Goddard Space Flight Center, Greenbelt, MD), U. SCHMIDT (Forschungszentrum Juelich GmbH, Germany), W. A. MATTHEWS (Department of Scientific and Industrial Research, Lauder, New Zealand), M. HAYASHI (Nagoya University, Toyokawa, Japan), and W. R. SHELDON (Houston, University, TX) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. D12, Aug. 20, 1992, p. 13,025-13,038. Research supported by CNES, CNRS, INSU, MOESC, et al. refs

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Ozone mixing ratios in the vicinity of the 525-K potential temperature surface in January and early February of 1990 were observed to decrease sharply across the edge of the vortex boundary, where the vortex position was estimated from Ertel's potential vorticity. The changes in NO(y) mixing ratio with respect to altitude measured on January 18 and 31 were quite well correlated with those of ozone between 15 and 24 km, indicating that NO(y) also had a large gradient across the edge of the vortex. This is interpreted as being mainly due to the significant denitrification that occurred inside the vortex. The total amount of gas and particulate phase HNO3 was close to the NO(y) amount at the altitude of the 22- to 23-km region, suggesting that the conversion of non-HNO3 reactive nitrogen to HNO3 had occurred with a PSC. C.A.B.

A92-55113**EIGENMODE ANALYSIS OF COUPLED MAGNETOHYDRODYNAMIC OSCILLATIONS IN THE MAGNETOSPHERE**

S. FUJITA (Meteorological College, Kashiwa, Japan) and V. L. PATEL (U.S. Navy, Naval Research Laboratory, Washington) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. A9, Sept. 1, 1992, p. 13,777-13,788. refs

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Results are presented from an eigenmode analysis of the coupled magnetohydrodynamic oscillations in the magnetosphere with a dipole magnetic field, which was carried out using the finite element method. It was found that the field-aligned current associated with the coupled global oscillations is most intense along a resonant field line. Around the resonant field line, field-aligned lower-intensity currents flow in the opposite direction. On the resonant field line, the field-aligned current has maximum intensity near the ionosphere. A radial component of the current was found to exist along the entire magnetospheric part of the resonant field line. The current flowing in the plane perpendicular to the ambient magnetic field does not form a loop and, therefore, the field-aligned component of the magnetic field perturbation is not enhanced on the resonant field line. I.S.

A92-55121* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

CORRELATION BETWEEN MAGNETIC AND ELECTRIC FIELD PERTURBATIONS IN THE FIELD-ALIGNED CURRENT REGIONS DEDUCED FROM DE 2 OBSERVATIONS

M. ISHII (Kyoto University, Japan), M. SUGIURA (Tokai University, Tokyo, Japan), T. IYEMORI (Kyoto University, Japan), and J. A. SLAVIN (NASA, Goddard Space Flight Center, Greenbelt, MD) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. A9, Sept. 1, 1992, p. 13,877-13,887. refs
(Contract MOESC-60420013; MOESC-63044070; MOESC-03044128)

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The satellite-observed high correlations between magnetic and electric field perturbations in the high-latitude field-aligned current regions are investigated by examining the dependence of the relationship between Delta-B and E on spatial scale, using the electric and magnetic field data obtained by DE 2 in the polar regions. The results are compared with the Pedersen conductivity inferred from the international reference ionosphere model and the Alfvén wave velocity calculated from the in situ ion density and magnetic field measurements. I.S.

A92-56653

ROCKET OBSERVATION OF ELECTRON FLUXES OVER A PULSATING AURORA

YOSHIFUMI SAITO, SHINOBU MACHIDA, MASAFUMI HIRAHARA, TOSHIFUMI MUKAI (Institute of Space and Astronautical Science, Sagami, Japan), and HIROSHI MIYAOKA (National Institute of Polar Research, Tokyo, Japan) *Planetary and Space Science* (ISSN 0032-0633), vol. 40, no. 8, Aug. 1992, p. 1043-1047, 1049-1054. refs

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Electron spectra over the energy range between 23 eV and 16 keV were measured with a quadrispherical electrostatic analyzer on board the S-520-12 rocket launched from Andoya, Norway, on February 26, 1990, into pulsating aurora. The rocket flew from one pulsating patch to another, and the spectral variation of the precipitating electron flux following this transition was observed. A long-time (greater than 20 s) variation of the electron energy spectra which reflects the spatial distribution of the pulsating patches was observed. Energy spectra of the precipitating electrons initially had power-law distributions, the flux intensity of which decreased as the rocket flew toward the boundary of the pulsating patch. A short-time (less than 20 s) variation of the electron energy spectra, namely, particle pulsation, whose period agreed with that derived from the variation in the optical emission, was observed. It is suggested that the well-defined precipitation events of the lower energy electrons was caused by acceleration due to the upward propagating kinetic Alfvén wave which was produced by the auroral precipitating electrons and resultant ionization of the neutral atmosphere. C.A.B.

A92-56657

A STUDY OF POLARIZATION OF IRREGULAR PULSATIONS OF DIMINISHING PERIOD AND THEIR GENERATION MECHANISM

M. HAYAKAWA (University of Electro-Communications, Chofu, Japan), S. SHIMAKURA, T. KOBAYASHI (Chiba University, Japan), and N. SATO (National Institute of Polar Research, Tokyo, Japan) *Planetary and Space Science* (ISSN 0032-0633), vol. 40, no. 8, Aug. 1992, p. 1081-1091. Research supported by National Institute of Polar Research. refs

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Results are presented of an investigation of the polarization of IPDPs observed in Iceland and at Syowa. It is found that the IPDP event which has so far been considered to be one single event, normally consists of a few subelements (or slopes). In general, the first major element occupying the lowest frequency range is left-handed circularly polarized, and the second major element in the higher frequency range is right-handed polarized. A hypothesis is presented to account for these observational facts. The protons with higher energy during the first injection seem to

encounter the bulge of the plasmasphere or plasmatail in the LT sector of 15-18 h and at L = 6-8, which would result in the generation of ion cyclotron waves. The delay time of the drift of protons for the first injection in a time-dependent convection electric field is calculated and compared with the observed time delay and the slope of the fine structures. If it is assumed that protons with lower energy are injected during a subsequent burst, they meet the plasmapause body at L of less than 5 and at LT of greater than 18 hr and, due to the ionospheric duct propagation over the great distance between the generation region and the observing stations, the polarization in Iceland would be right-handed, which is consistent with observations. C.A.B.

A92-57392

EMERGENT RADIATION FROM THE ATMOSPHERE BOUNDED BY THE TWO HALF LAMBERT SURFACES COMPOSED OF DIFFERENT ALBEDO. II

T. TAKASHIMA and K. MASUDA (Meteorological Research Institute, Tsukuba, Japan) *Astrophysics and Space Science* (ISSN 0004-640X), vol. 193, no. 2, July 1992, p. 289-302. refs

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The emergent radiation from the atmosphere bounded by the two half Lambert surfaces composed of different albedo is computed in order to evaluate the effect of the nonuniform surface albedo on the emergent radiation from the atmosphere. The atmosphere, which is composed of aerosol, molecules, and absorbent gases, is assumed to be homogeneous. The present approach makes it possible to quantitatively examine the radiative transfer trend near the boundary of two half surfaces. The upward radiance is evaluated using the present scattering approximation method if the surface albedo is less than about 0.3. This method is argued to be a first step in extending the 1D radiative transfer model to 2D using the doubling-adding method. P.D.

N92-10258# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

THEORETICAL ESTIMATION OF THE VIBRATIONAL TEMPERATURES OF N₂ MOLECULES IN THE IONOSPHERE AND IN THE LABORATORY SIMULATED PLASMA

K. S. KALPURI and K.-I. OYAMA Jun. 1991 16 p
(ISSN 0285-6808)

(ISAS-642) Avail: CASI HC A03/MF A01

The vibrational temperature of excited nitrogen molecules (N₂) are estimated theoretically for the case of ionosphere as well as for the lab simulated plasma, considering the various chemical reactions leading to the production and loss of N₂ molecules. It was found that even in the case when quenching of the excited molecules by O and CO₂ is considered, the vibrational temperature, T_{sub v}, is higher than the neutral temperature, T_{sub n}, below about 105 km but the difference decreases and about 120 km, the value of T_{sub v} is less than T_{sub n}. However, for no quenching case, the vibrational temperature can be as high as 1600 K at 150 km. The vibrational temperature for the lab simulated plasma on the other hand was found to be high (1500 K or more), the absolute value being dependent upon the concentration of O₂ in the gas mixture taken and the intensity of UV light used for excitation of nitrogen molecules. Author

N92-10259# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

ELECTRON TEMPERATURES IN THE E-REGION OF THE IONOSPHERE

K. S. KALPURI and K.-I. OYAMA Jun. 1991 20 p
(ISSN 0285-6808)

(ISAS-641; DE92-750870) Avail: CASI HC A03/MF A01

Various heating and cooling mechanisms which are operative in the lower E region are discussed and their relative importance in different altitude range is shown. These heating and cooling rates are then used to derive the electron temperature, T_{sub e}. The calculated values of electron temperatures are found to be higher than neutral temperature through out the altitude range 100 to approx. 150 km, with the difference increasing with increase in altitude. However, compared to observed values of T_{sub e},

the calculated values are still smaller below about 130 km. Above this altitude, the calculated values become larger. Estimation of $T_{sub e}$ for different, suggested values of heating efficiency due to dissociative recombination, show that $T_{sub e}$ profile obtained even by assuming a constant value of 1.3 eV is in fairly good agreement with those derived based on variable values of this parameter. Author

N92-23262# National Inst. for Fusion Science, Nagoya (Japan). **DEVELOPMENT OF 3-DIMENSIONAL COMPACT MAGNETIC DOSIMETER FOR ENVIRONMENTAL MAGNETIC FIELD MONITORING**

YUSUKE KUBOTA, HARUO OBAYASHI, AKIRA MIYAHARA, KAZUKO OHNO, KOUICHI NAKAMURA, and KENZI HORII. Jul. 1991 48 p. In JAPANESE; ENGLISH summary (DE92-750825; NIFS-MEMO-2) Avail: CASI HC A03/MF A01

A computer-driven, three-dimensional magnetic fluxmeter to be used for magnetic field dosimetry has been developed. A magnetic monitor applicable to this object should be measurable to an absolute value of local magnetic field strength and also be able to record its time integration as a measure of exposed dose to the magnetic field. The present fluxmeter consists of signal amplifiers, rectifiers, an A/D converter, and a pocket computer (PC). The signal outputs from the sensors are processed with the PC to compose an absolute strength of magnetic flux density and its time-integrated value. The whole system is driven by a battery and is quite compact in size to be used as a handy portable system. Further details of the design, idea, construction, specification, and testing result of the fluxmeter are described. The measurable range are from 0.4G to 20,000G in normal mode and 8mG to 400G in high-sensitivity AC mode, and the sensitivity is well independent of the magnetic field direction. These measured data are displayed in real time on the LCD panel of the PC and memorized in RAM files. Possible application of the fluxmeter is discussed with special attention to the search of the leakage and/or disturbing error fields around LHD (Large Helical Device) and other magnetic systems, the individual dose control to the workers in strong magnetic fields, and the evaluation of the effects of long irradiation of magnetic fields. DOE

N92-26297# Nagoya Univ., Toyokawa (Japan). STE Lab. **RESEARCH PROGRAMMES AT SVABARD (NORWAY)** TAKASI OGUTI. In ESA, Cluster Dayside Polar Cusp p 15-18 Dec. 1991

Copyright Avail: CASI HC A01/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 50 Dutch guilders

Research programs of aurorae, ionospheric absorption, electric and magnetic fields at Svalbard for the study of polar cusp dynamics, in connection with boundary layer processes, are described. The necessity for networks of low light level television cameras, imaging riometers and magnetic stations is emphasized in conjunction with an incoherent scatter radar. The networks would provide data of fine space time resolution and serve as a reference frame for satellite measurements. Significant conjugate studies could then be made between polar ionospheric and magnetospheric phenomena. ESA

N92-28588*# Nagoya Univ. (Japan). Water Research Inst. **THERMAL EVOLUTION AND CHEMICAL DIFFERENTIATION OF THE TERRESTRIAL MAGMA OCEAN**

Y. ABE. In Lunar and Planetary Inst., Workshop on the Physics and Chemistry of Magma Oceans from 1 Bar to 4 Mbar p 9-10 1992

Avail: CASI HC A01/MF A01

The release of gravitational energy resulted in global melting and formation of a magma ocean during accretion of the Earth. Although it is believed that the formation of the magma ocean resulted in gravitational differentiation of melt and solid, the differentiation might be disturbed by the following processes: (1) convective mixing; (2) cooling and solidification; and (3) growth of the earth, which results in secular increase of pressure, and stirring by planetesimal impacts. The purpose of this study is to investigate

the differentiation processes of the terrestrial magma ocean by taking into account various disturbing processes. Author

N92-28606*# Tohoku Univ., Sendai (Japan). Inst. of Mineralogy, Petrology, and Economic Geology.

TERRESTRIAL MAGMA OCEAN AND CORE SEGREGATION IN THE EARTH Abstract Only

EIJI OHTANI (Tohoku Univ., Sendai (Japan).) and NAOYOSHI YURIMOTO (Tsukuba Univ., Japan) In Lunar and Planetary Inst., Workshop on the Physics and Chemistry of Magma Oceans from 1 Bar to 4 Mbar p 44-45 1992
Avail: CASI HC A01/MF A01

According to the recent theories of formation of the earth, the outer layer of the proto-earth was molten and the terrestrial magma ocean was formed when its radius exceeded 3000 km. Core formation should have started in this magma ocean stage, since segregation of metallic iron occurs effectively by melting of the proto-earth. Therefore, interactions between magma, mantle minerals, and metallic iron in the magma ocean stage controlled the geochemistry of the mantle and core. We have studied the partitioning behaviors of elements into the silicate melt, high pressure minerals, and metallic iron under the deep upper mantle and lower mantle conditions. We employed the multi-anvil apparatus for preparing the equilibrating samples in the ranges from 16 to 27 GPa and 1700-2400 C. Both the electron probe microanalyzer (EPMA) and the Secondary Ion Mass spectrometer (SIMS) were used for analyzing the run products. We obtained the partition coefficients of various trace elements between majorite, Mg-perovskite, and liquid, and magnesio-wustite, Mg-perovskite, and metallic iron. The examples of the partition coefficients of some key elements are summarized in figures, together with the previous data. We may be able to assess the origin of the mantle abundances of the elements such as transition metals by using the partitioning data obtained above. The mantle abundances of some transition metals expected by the core-mantle equilibrium under the lower mantle conditions cannot explain the observed abundance of some elements such as Mn and Ge in the mantle. Estimations of the densities of the ultrabasic magma Mg-perovskite at high pressure suggest existence of a density crossover in the deep lower mantle; flotation of Mg-perovskite occurs in the deep magma ocean under the lower mantle conditions. The observed depletion of some transition metals such as V, Cr, Mn, Fe, Co, and Ni in the mantle may be explained by the two stage process, the core-mantle equilibrium under the lower mantle conditions in the first stage, and subsequent downwards separation of the ultrabasic liquid (and magnesio-wustite) and flotation of Mg-perovskite in the lower mantle. Author

N92-28608*# Hiroshima Univ. (Japan). Dept. of Earth and Planetary Systems Sciences.

COOLING OF THE MAGMA OCEAN DUE TO ACCRETIONAL DISRUPTION OF THE SURFACE INSULATING LAYER Abstract Only

SHO SASAKI. In Lunar and Planetary Inst., Workshop on the Physics and Chemistry of Magma Oceans from 1 Bar to 4 Mbar p 47-48 1992

Avail: CASI HC A01/MF A01

Planetary accretion has been considered as a process to heat planets. Some fraction of the kinetic energy of incoming planetesimals is trapped to heat the planetary interior (Kaula, 1979; Davies, 1984). Moreover, blanketing effect of a primary atmosphere (Hayashi et al., 1979; Sasaki, 1990) or a degassed atmosphere (Abe and Matsui, 1986; Zahnle et al., 1988) would raise the surface temperature of the Earth-size planets to be higher than the melting temperature. The primordial magma ocean was likely to be formed during accretion of terrestrial planets. In the magma ocean, if crystallized fractions were heavier than melt, they would sink. But if solidified materials were lighter than the melt (like anorthosite of the lunar early crust) they would float to form a solid shell surrounding the planet. (In an icy satellite, solidified water ice should easily float on liquid water because of its small density.) The surface solid lid would prevent efficient convective heat transfer and slow the interior cooling. Consider that the accretion of

planetesimals still continues in this cooling stage. Shock disruption at planetesimal impact events may destroy the solid insulating layer. Even if the layer survives impacts, the surface layer is finally overturned by Rayleigh-Taylor instability, since accreting materials containing metals are heavier than the surface solidified lid of silicates. Author

N92-28613* Tokyo Inst. of Tech. (Japan). Earth and Planetary Sciences.

EVIDENCES FOR THE TERRESTRIAL MAGMA OCEAN FROM HIGH-PRESSURE MELTING EXPERIMENTS Abstract Only
EIICHI TAKAHASHI / In Lunar and Planetary Inst., Workshop on the Physics and Chemistry of Magma Oceans from 1 Bar to 4 Mbar p 56-57 1992
Avail: CASI HC A01/MF A01

In order to study the early evolutionary history of our planet, the author has carried out a series of melting experiments on primitive mantle peridotites. Using a new multi-anvil apparatus (SPI-1000), the author revisited the melting study on mantle peridotites and also started a melting study for representative chondrite compositions in the pressure range of 25 GPa. The updated phase diagram for the peridotite is shown as is the preliminary melting phase diagram for Allende C3 chondrite. The *liquidus* and *solidus* of the Allende chondrite are extrapolated based on experimental results at 24 to 26 GPa on the same rock. H.A.

N92-29312* Tokyo Metropolitan Univ. (Japan). Dept. of Electronics and Information Engineering.

LIDAR MEASUREMENTS OF METALLIC SPECIES IN MESOPAUSE REGION

CHIKAO NAGASAWA and MAKOTO ABO / In NASA. Langley Research Center, Sixteenth International Laser Radar Conference, Part 1 p 313-316 Jul. 1992
Avail: CASI HC A01/MF A04

Sodium density distributions were measured over more than 20 nights since Jul. 1991 at Tokyo Metropolitan University. Our sodium lidar specifications are shown. The lidar consists of a dye laser that is pumped by a pulsed Nd:YAG laser. The dye laser is tuned to the D2 resonant absorption line of Na at the wavelength of 589 nm. A small fraction of the output beam is directed to a hollow-cathode lamp. The precise tuning of the Na D2 line is accomplished by monitoring the signal obtained from the hollow-cathode lamp and controlling the grating in the dye laser oscillator cavity. The raw data for each profile were obtained by firing the laser 5000 times for approximately 8.5 minutes. We have observed the sporadic sodium layers three times during the observation period. Recently, lidar measurements of iron atoms were also performed. Other aspects of this investigation are presented. Author

N92-70032 Kakioka Magnetic Observatory (Japan).

REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY: GEOELECTRICITY

1991 36 p
(KMO-158) Avail: CASI HC A03

The following data are presented in tabular form: (1) hourly values of atmospheric electric potential gradient at Kakioka, 1990; (2) hourly values of earth-current potential gradient at Kakioka, 1990; and summary results of geoelectric observations at Memambetsu and Kanoya, 1990. Author

N92-70193 Kakioka Magnetic Observatory (Japan).

REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY: GEOMAGNETISM

1991 221 p
(KMO-157) Avail: CASI HC A10

The results of the magnetic observations carried out at the Kakioka Magnetic Observatory, its two branches at Memambetsu and Kanoya, and an unmanned observatory at Chichijima are given. These three observatories are sufficiently free from artificial magnetic disturbances. Data is given in tabular form. Author

N92-70961 National Inst. of Polar Research, Tokyo (Japan).

JARE DATA REPORTS. NO. 159 (UPPER ATMOSPHERE PHYSICS 7). UPPER ATMOSPHERE PHYSICS DATA, SYOWA AND ASUKA STATIONS, 1987

HIROSHI MIYAOKA (Ministry of Posts and Telecommunications, Tokyo, Japan), KUNIO UCHIDA (Ministry of Posts and Telecommunications, Tokyo, Japan), HIROYUKI MUKAI (Ministry of Posts and Telecommunications, Tokyo, Japan), HIROAKI SAITO (University of Electro-Communications, Tokyo, Japan), JUNPEI AKAMATSU (University of Electro-Communications, Tokyo, Japan), KAZUO SHIBUYA, RYOKI SAKAI, MASARU AYUKAWA, NATSUO SATO, and TAKAO HOSHIAI, ed Mar. 1990 308 p (ISSN 0075-3343)
Avail: CASI HC A14

Upper atmosphere physics data acquired by the 'Upper Atmosphere Physics Monitoring Systems' at Syowa Station and Asuka Station in 1987 are summarized. The items of observations at Syowa Station are geomagnetism, ELF-VLF wave, ionosphere, and aurora. The item for Asuka Station is geomagnetism. An outline of the Upper Atmosphere Physics Monitoring Systems installed at the stations is addressed as well as the specifications of the observation instruments and the data acquisition systems. The recording periods, format of the compiled digital data, magnetograms and frequency-time spectra of magnetic pulsations in the period of January 1 - December 31, 1987 for Syowa Station and February 19 - December 31, 1987 for Asuka Station are also addressed. I.I.C.

N92-70963 National Inst. of Polar Research, Tokyo (Japan).

JARE DATA REPORTS. NO. 154 (IONOSPHERE 41). RECORDS OF RADIO AURORA AT SYOWA STATION, ANTARCTICA, 1988

HIDEO MAENO, ATSUSHI OHTSUKA, TAKAO HOSHIAI, ed., MASAKI EJIRI, ed., KATSUTADA KAMINUMA, ed., IKUO KUSHIRO, ed., MASAYUKI TAKAHASHI, ed., OKITSUGU WATANABE, ed., TORAO YOSHIKAWA, ed., YOSHIYUKI FUJII, ed. et al. Mar. 1990 37 p (ISSN 0075-3343)
Avail: CASI HC A03

Observation of ionosphere irregularities was carried out by Syowa Station, Antarctica, by means of an auroral radar since March 1966. A report was prepared which includes the periods of 112 MHz radio auroral echoes detected in 1988. Two kinds of data are available: (1) 35 film records of radio auroral echo intensity with range (A-scope) and range-time intensity (A'-scope); and (2) chart records of the time variation of echo intensity. Author

METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

A92-14847

EVOLUTION OF THE KINEMATIC STRUCTURE WITHIN A MESO-BETA-SCALE CONVECTIVE SYSTEM IN THE GROWING AND MATURE STAGES

KENJI AKAEDA, TATSUO YOKOYAMA, AKIRA TABATA, MASAHITO ISHIIHARA, and HITOSHI SAKAKIBARA (Meteorological Research Institute, Tsukuba, Japan) Monthly Weather Review (ISSN 0027-0644), vol. 119, Nov. 1991, p. 2664-2676. refs
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A case study is made of the formation of a meso-beta-scale convective system that constitutes a part of a cloud cluster. The convective system was formed near a relatively small island in the subtropical ocean. The evolution process and the fine structure of the convective system were investigated by using mainly Doppler radar data. The evolution process of the convective system was divided into two stages: stationary stage (stage I) and propagating

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stage (stage II). Convective-scale circulations predominated in stage I, while a mesoscale circulation, similar to that found in squall lines, predominated in stage II. A thick layer of rear inflow was one of the characteristic features in the mesoscale circulation, and the rear inflow contributed to the formation of a severe gust front that exceeded 25 m/s. The total area of strong echoes remained nearly constant after the mesoscale circulation was established. It is suggested that the squall-line-type circulation is important to maintain this strong convective system. Depending on the differences of internal circulation between stage I and stage II, the features of cells that constituted the convective system changed to an organized multicellular type in stage II. Author

A92-14850

A NUMERICAL STUDY OF THE MESOSCALE CONVECTIVE SYSTEM OBSERVED OVER OKINAWA ISLAND IN JUNE 1987
CHUAN-YONG CHANG and MASANORI YOSHIZAKI (Tokyo, University, Japan) Monthly Weather Review (ISSN 0027-0644), vol. 119, Nov. 1991, p. 2724-2733. Research supported by MOESC and NSCRC. refs
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A mesoscale convective system (MCS) observed over Okinawa Island in Japan during the Baiu season is studied numerically by using a two-dimensional compressible model with warm-raincloud physics. The initial formation of the system on the leeside of the mountain and two stages of the evolution (stationary and propagating stages) are simulated. The stationary stage, which is made by the piling of the cold pool in the lower layer for the system to move against the flow as a density current, is more distinguished by the orographic effects of forced lifting to the MCS in the upwind side of the mountain and damming the outflow spreading in the leeside. One cold-air-overflows the mountain crest, the system moves fast upwindward and the propagating stage starts. The simulated MCS has a vertical structure similar to those observed in midlatitude tropical squall lines. Author

A92-16347

ONE-MINUTE RAIN RATE DISTRIBUTIONS IN JAPAN DERIVED FROM AMEDAS ONE-HOUR RAIN RATE DATA
YOSHIO KARASAWA and TAKASHI MATSUDO (Kokusai Denshin Denwa Co., Ltd., Research and Development Laboratories, Kamifukuoka, Japan) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. 29, Nov. 1991, p. 890-898. refs
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By examining measured 1-min rain rate data presently available and 1-h rain rate data obtained by AMEDAS (Automated Meteorological Data Acquisition System) in Japan, a simple conversion method of 1-h rain rate data to 1-min rain rate distribution is presented. The prediction accuracy of the method is evaluated, and good accuracy is confirmed. Maps are given of the mean and standard deviation (normalized by the mean value) of 1-min rain rate for 0.01 percent of time based on AMEDAS data in Japan. Moreover, the effect of a record-breaking heavy rain even on long-term statistics is discussed. Since the method has been successfully applied to various locations in Japan, it can be expected to be applicable to regions of the world where 1-min rain rate data have not yet been available. I.E.

A92-17933

SEA-SALT PARTICLES IN THE MIDDLE TROPOSPHERE OVER THE TROPICAL PACIFIC OCEAN
MIWAKO IKEGAMI, KIKUO OKADA, and YUJI ZAIZEN (Meteorological Research Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, March 1991, p. 31-41. refs
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During the INSTAC-I flight tests, aerosol number-size distribution was measured in the middle troposphere at four to five km altitude from 0 deg N to 34 deg N by utilizing an optical counter. The upward transport of sea-salt particles through convective clouds is considered to be responsible for high particle concentrations in the midtropical troposphere. R.E.P.

A92-18164

BEHAVIOR OF CUMULUS ACTIVITY AND THE STRUCTURES OF CIRCULATIONS IN AN 'AQUA PLANET' MODEL. I - THE STRUCTURE OF THE SUPER CLUSTERS. II - EASTWARD-MOVING PLANETARY SCALE STRUCTURE AND THE INTERTROPICAL CONVERGENCE ZONE

ATUSI NUMAGUTI and YOSHI-YUKI HAYASHI (Tokyo, University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Oct. 1991, p. 541-561, 563-579. Research supported by MOESC. refs
Copyright

Results are presented of GCM experiments performed in order to examine the structure of cumulus activity and its parameter dependence. Findings of the analyses focusing on the superclusters are described. The superclusters are expressed in the model as continuously-moving precipitating areas of the grid scale. The superclusters become more active when a warmer SST is used. The 30-day oscillation, which is an eastward-moving planetary scale structure, is more distinct when a colder SST is used. At the double ITCZ latitudes in the experiments with Kuo's (1974) cumulus parameterization, there are areas of high cumulus activity on the grid scale, which are moving eastward continuously. In the experiment with moist convective adjustment, westward-moving areas of high cumulus activity associated with vorticity, which correspond well to the easterly wave disturbances in the real tropics, are observed. It is found that a process which can be called 'evaporation-wind feedback for the zonal mean field' exists and contributes to the separation of the ITCZ into double bands in the experiments with Kuo's parameterization. C.A.B.

A92-19292

MESOSCALE CONVECTIVE COMPLEXES IN THE WESTERN PACIFIC REGION

DAVID MILLER and J. M. FRITSCH (Pennsylvania State University, University Park) Monthly Weather Review (ISSN 0027-0644), vol. 119, Dec. 1991, p. 2978-2992. refs
(Contract NSF ATM-87-11014; AF-AFOSR-88-0050)
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Full-disk enhanced IR satellite imagery is used to perform a climatological investigation of mesoscale convective complexes (MCCs) during 1983-1985 over the western Pacific region (WPR). The results indicate that MCCs are common in the WPR and display many of the same characteristics as those found in the Americas. The systems are nocturnal and tend to form over or in the immediate vicinity of land. Cold-cloud shields in the Americas last for about 10 h, while WPR shields last about 11 h. The cold-cloud-shield size distribution is similar to that of the Americas, with most systems exhibiting areas between 200,000 and 300,000 sq km. Seasonal distributions of WPR systems are also similar to that in the Americas. Specifically, the frequency of midlatitude systems peaks in late spring and early summer while low-latitude MCCs are distributed uniformly throughout the warm season. It is concluded that the strong similarity of the properties and environment of WPR MCCs to that in the Americas indicates that they are essentially the same phenomenon. P.D.

A92-19626

REFLECTED SOLAR FLUX FOR HORIZONTALLY INHOMOGENEOUS ATMOSPHERES

TAKAHISA KOBAYASHI (Meteorological Research Institute, Tsukuba, Japan) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 48, Nov. 15, 1991, p. 2436-2447. refs
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Discrete-ordinate solutions for a multidimensional radiative transfer equation for a collimated source are presented. Numerical computations for a medium of a spatial structure of radiative properties, which is specified by a Gaussian or a cosine function, show that spatial heterogeneity makes the atmosphere less reflective. The decrease in reflectivity depends on the nature of the spatial heterogeneity and is qualitatively explained by an approximation using a linear weighting of the radiative properties of plane-parallel clouds; the nonlinear relationship between a plane-parallel albedo and optical thickness leads to a lower

reflectivity for a heterogeneous atmosphere than that for a plane-parallel medium of an equivalent domain-averaged optical thickness. Numerical calculations show that the intrinsic effects are well characterized by considering the similar effects to the cloud-cloud interaction and the enhanced illumination applied for broken cloud fields. P.D.

A92-22682

WIND AND TEMPERATURE REGIME IN MIZUHO PLATEAU, EAST ANTARCTICA

T. KIKUCHI (Kochi University, Japan), K. SATOW (Nagaoka College of Technology, Japan), T. OHATA (Nagoya University, Japan), T. YAMANOUCI, and F. NISHIO (National Institute of Polar Research, Tokyo, Japan) (Remote sensing in the polar regions; IAMAP, Scientific Assembly, 5th, Symposium, Reading, England, Aug. 8, 1989, Selected Papers. A92-22676 08-47) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, Jan. 10, 1992, p. 67-79. refs

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Data from a ground-based study of the Antarctic plateau region are employed to assess the accuracy of remotely sensed climatological and geographical data. Snow temperatures at 10-m depths and snow-surface topologies are employed to assess annual mean temperatures and prevailing wind directions respectively. Remotely sensed data are incorporated into these data, and the results are compared to NOAA channel-5 brightness temperatures and wind data. The 12-micron NOAA-derived temperatures are found to agree with the snow temperatures, and an identifiable distinction is noted between the katabatic wind system and the system of synoptic disturbances. The ridges and the troughs of the plateau are examined, and a noticeable climatic distinction is found which relates to the different katabatic-wind effects in the two types of area. C.C.S.

A92-22685

CLOUD DISTRIBUTION IN THE ANTARCTIC FROM AVHRR DATA AND RADIATION MEASUREMENTS AT THE SURFACE

TAKASHI YAMANOUCI and SADA O KAWAGUCHI (National Institute of Polar Research, Tokyo, Japan) (Remote sensing in the polar regions; IAMAP, Scientific Assembly, 5th, Symposium, Reading, England, Aug. 8, 1989, Selected Papers. A92-22676 08-47) International Journal of Remote Sensing (ISSN 0143-1161), vol. 13, Jan. 10, 1992, p. 111-127. refs

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Cloud-cover algorithms are evaluated by comparing results based on AVHRR data to the corresponding observed cloud conditions and ground-based data on the downward longwave radiation. Cloud cover is assessed with information on the brightness-temperature difference from IR channels 3 and 4 during the sunlit season and with the channels 4 and 5 at all times. The data are treated with the algorithm by Yamanouchi et al. (1987), and the cirrus conditions are studied with the process outlined by Inoue (1985). The channel 3-4 data compare favorably with the observed surface-cloud amounts and downward longwave fluxes. The data corresponding to channels 4-5 demonstrate a reasonable correlation, but the correlation is found to be better during the sunlit season. The methods described can be employed for cloud-cover studies over long periods of time with AVHRR data from the polar regions. C.C.S.

A92-24912

AN ANALYSIS TECHNIQUE FOR DERIVING VECTOR WINDS AND IN-BEAM INCIDENCE ANGLES FROM RADAR INTERFEROMETER MEASUREMENTS

M. F. LARSEN, R. D. PALMER, S. FUKAO, R. F. WOODMAN, M. YAMAMOTO, T. TSUDA, and S. KATO (Kyoto University, Uji, Japan) Journal of Atmospheric and Oceanic Technology (ISSN 0739-0572), vol. 9, Feb. 1992, p. 3-14. Research supported by MOESC. refs

(Contract F49620-88-C-0121)

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A method is presented for deriving horizontal velocities, vertical velocities, and in-beam incidence angles from radar interferometer

data. All parameters are calculated from the slope and intercept of straight lines fitted in a least-squares sense to the variation of the signal phase as a function of radial velocity for each pair of receiving antennas. Advantages of the method are that the calculations are computationally fast and simple, and the analysis leads to relatively simple expressions for the uncertainty in the velocity measurements. Author

A92-25053

GUST AND DOWNWARD MOMENTUM TRANSPORT IN THE ATMOSPHERIC SURFACE LAYER

TAIICHI HAYASHI (Kyoto University, Wakayama, Japan) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 58, no. 1-2, Jan. 1992, p. 33-49. refs

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The intermittent structure of the turbulent wind field in the atmospheric surface layer is investigated by conditional sampling methods. The results show that downward momentum can be transported efficiently during a peak gust. The horizontal structure of the gust is also revealed by observing the spatial structure of wind speed fluctuations from a network of 28 anemometers. The high wind region consists of a gust front with a sudden increase of wind speed at the front and a slow decrease to its rear. The development of the gust front is related closely to the momentum flux during the short time of passage of the gust. Author

A92-25123

FEASIBILITY STUDY OF DERIVATION OF CIRRUS INFORMATION USING POLARIMETRIC MEASUREMENTS FROM SATELLITE

KAZUHIKO MASUDA and TSUTOMU TAKASHIMA (Meteorological Research Institute, Tsukuba, Japan) Remote Sensing of Environment (ISSN 0034-4257), vol. 39, Jan. 1992, p. 45-59. refs

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Monitoring techniques for deriving cirrus information over the ocean using polarimetric measurements from satellite are studied. Radiance and degree of linear polarization of the upwelling radiation at the top of a model atmosphere-ocean system are computed at the wavelength of 0.88 micron with the aid of the doubling-adding method, and where cirrus cloud is assumed to be composed of water droplets or randomly oriented hexagonal ice crystals (columns and plates). The computational results show the following features. Degree of polarization observed at the Brewster angle in the solar plane is suitable to derive cloud optical thickness (τ) for large solar zenith angles, particularly in the case of τ less than about 5 while the radiance off the sunglint is suitable to infer τ in the range of τ less than about 30. However, for improvement of accuracy, cloud information such as thermodynamic phase, size distribution, and shape of cloud particles should be separately obtained, in particular for utilization of degree of polarization. Author

A92-26837* National Aeronautics and Space Administration, Washington, DC.

TROPICAL RAINFALL MEASURING MISSION (TRMM) PROJECT. I - INTRODUCTION

JOHN S. THEON (NASA, Washington, DC) and NOBUYOSHI FUGONO Communications Research Laboratory, Review (ISSN 0914-9279), vol. 36, no. 11, June 1990, p. 1-9. In Japanese. refs

Results of a 1-year USA-Japan study of the feasibility of the joint TRMM project are briefly reviewed. The TRMM mission will fly four precipitation sensors, a single-frequency radar, two types of microwave radiometers, and a visible and infrared radiometer. The scientific background of the mission and its organizational and engineering aspects are summarized. V.L.

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A92-26866

ON THE SELECTION OF EASTWARD-PROPAGATING MODES APPEARING IN THE WAVE-CISK MODEL AS TROPICAL INTRASEASONAL (30-60-DAY) OSCILLATIONS - LINEAR RESPONSES TO LOCALIZED HEATING MOVING IN THE EAST-WEST DIRECTION ON THE EQUATORIAL BETA PLANE
MASANORI YOSHIZAKI (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 595-608. refs
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Results are presented of an analytical investigation of linear responses to localized heating, which moves westward or eastward uniformly, on the equatorial beta plane. Response patterns are examined for a simple heating profile having one vertical mode, a Gaussian meridional mode, and a Gaussian longitudinal profile with scale comparable to the equatorial radius of deformation. For the case of fast eastward-moving heating, the response pattern is mainly produced by the Kelvin wave, and no wave train appears. For the case of slowly eastward-moving or stationary heating, the response pattern due to the Kelvin wave is dominant to the east of the heating, while vortical motions due to the Rossby wave are found to the west. Eastward-propagating growing and westward-propagating nondeveloping modes were obtained in the positive-only wave-CISK model on the equatorial beta plane.

C.A.B.

A92-26867

'COUPLING DEVELOPMENT' - AN EFFICIENT MECHANISM FOR THE DEVELOPMENT OF EXTRATROPICAL CYCLONES
IZURU TAKAYABU (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 609-628. refs
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A beta-plane-channel, dry primitive-equation model is used in a numerical investigation of the 'coupling development', or rapid cyclogenesis with a coupling process, of the upper and the lower tropospheric vortices. The 'coupling development' occurred when a lower vortex is initially located at the latitude of the jet axis, and an upper vortex to the northwest of the lower vortex. Three stages of the 'coupling development' were found. Results of a data analysis of the April 25-28, 1986, cyclone around the Japanese islands are presented. Two characteristics in that cyclone are considered: the northward penetration of the lower vortex before the 'coupling'; and the downward intrusion of the upper vortex along the sloping isentropic surface, and the 'coupling' with the lower vortex at the beginning of the rapid development. These observed features are consistent with numerical results, which indicate the importance of the 'coupling development' mechanism in midlatitudinal cyclone development.

C.A.B.

A92-26869

NUMERICAL MODELING OF THE CONVECTIVE SNOW CLOUD OVER THE SEA OF JAPAN - PRECIPITATION MECHANISM AND SENSITIVITY TO ICE CRYSTAL NUCLEATION RATES
MOTOHKI IKAWA, HAKARU MIZUNO, TAKAYO MATSUO, MASATAKA MURAKAMI, YOSHINORI YAMADA, and KAZUO SAITO (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 641-667. Research supported by Science and Technology Agency of Japan. refs
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Attention is given to a bulk parameterization scheme of cloud microphysics which predicts not only the number concentrations of cloud ice and snow but also that of graupel, in addition to the mixing ratios of six water species. This scheme is applied to the 3D simulation of the convective snow cloud observed over the Sea of Japan on February 4, 1989, with a cloud top temperature at -20 C. Sensitivity experiments on the amplification of various ice nucleation rates are conducted to simulate the cloud more realistically and to observe the effects of the increase of the number concentration of ice crystals on the precipitation formation of convective clouds. The increase in the number concentration of ice crystals to a value of 100,000 to 1,000,000/cu m results in an

increase of snow in mass and number and a decrease of radar reflectivity. The further increase in the number concentration of ice crystals to the value $10 \exp 77/\text{cu m}$ results in the suppression of precipitation, glaciation of clouds with little cloud water, and the suspension of abundant snow in the air.

C.A.B.

A92-26870

POLAR LOW DEVELOPMENT OVER THE EAST COAST OF THE ASIAN CONTINENT ON 9-11 DECEMBER 1985

KOZO NINOMIYA (Japan Meteorological Agency, Tokyo) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 669-685. refs
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The development of a polar low during December 9-11, 1985, over the east coast of the Asian continent is investigated. The low-level strong thermal gradient was maintained along the east coast of the continent. When a large-scale trough including a cold cut-off vortex approached the east coast, a synoptic-scale low developed over the northwestern Pacific to the east of Japan, and the cyclonic circulation of the synoptic-scale low predominated over the coastal zone. The easterly winds in the northwestern quadrant of the synoptic-scale low advected the warm air from the Pacific to the continent, while the westerly winds in the southwestern quadrant of the low advected the cold air from the continent. Consequently, the N-S thermal gradient was enhanced in the western part of the low. This was the frontogenesis in horizontal shear flows, and a W-E oriented trough (shear line) formed in the lower troposphere in the western part of the synoptic-scale low.

C.A.B.

A92-26871

QUASI-PERIODIC VARIABILITIES OF WIND-STRESS FIELDS OVER THE PACIFIC OCEAN RELATED TO ENSO EVENTS

KUNIO KITSUWADA (Tokyo, University, Otsuchi, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 687-700. refs
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The spatial character of interannual variability is described on the basis of two datasets of monthly-mean wind stress, estimated from Ships-of-Opportunity data covering the North Pacific and the Pacific trade-wind region. Two characteristic time scales related to the occurrence of ENSO events are given by period bands around 3.6 yr, El Nino (EN), and 2 yr, quasi-biennial (QB). Spatial features of wind stress variations in the two period bands are described by patterns derived from correlations between SST in the area and the zonal and meridional components of the wind stress in the datasets. The variation in the EN-band around 3.6 yr is coherent over a large portion of the study areas covering the extratropics as well as the tropics and has a Pacific-basin scale. It is suggested that the QB-period variation is characteristic of the tropical zone covering the Indian Ocean and that its phase relationship with the EN-period variation is important for the occurrence of ENSO events.

C.A.B.

A92-26872

THE CLOUD BASE STRUCTURE OF STRATOCUMULUS CLOUDS

KATSUHIRO KIKUCHI, MASA HARU FUJII, RYUICHI SHIROOKA, and SUSUMU YOSHIDA (Hokkaido University, Sapporo, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 701-708. Research supported by MOESC. refs
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Lidar measurements of stratospheric and tropospheric aerosol layers above 2.25 km were made at the fundamental wavelength of a Nd:YAG laser in order to elucidate the cloud base structure of a widespread stratocumulus cloud. A set of stereophotographs was processed by an image analyzer and the edge lines of unevenness of the cloud base were obtained. The edge lines of unevenness of a pair of stereophotographs were used to select 100 to 200 corresponding points on the edge lines and obtain the points' heights. The stratocumulus clouds analyzed were found to have an unevenness of 300 m or more at the cloud base. A

correlation between the height and the brightness of the cloud base was obtained on the basis of a set of stereophotographs. It was demonstrated that the relationship between the size and depth of unevenness of the stratocumulus clouds resembled a hemisphere when the wind velocity was weak and wind shear was not strong up to the cloud base height. C.A.B.

**A92-26873
LIDAR MEASUREMENTS OF STRATOSPHERIC AND
TROPOSPHERIC AEROSOLS AT 1064 NM USING A NEW AND
LOW-NOISE PHOTOMULTIPLIER**

OSAMU UCHINO (Meteorological Research Institute, Tsukuba, Japan), HIDEYUKI TAKASHIMA (Tsukuba, University, Japan), and ISAO TABATA (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 709-713. Research supported by Special Coordination Funds for Promoting Science and Technology of Japan. refs
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Using a new type of photomultiplier (PMT) tube R3236 cooled to -30 C, and a photon counting method, lidar measurements of stratospheric aerosols and tropospheric aerosols above an altitude of 2.25 km were made at the fundamental wavelength of 1064 nm of a Nd:YAG laser which is sensitive to aerosol scattering. The PMT R3236 was found to be useful even for measurements of stratospheric aerosols near the background level. The average of the integrated backscattering coefficient above tropopause was 3.3×10^{-5} sr at Tsukuba (36.1 deg N, 140.1 deg E) during November through December 1988. Tropospheric aerosol layers in the free atmosphere were frequently observed, and the altitude of the maximum scattering ratio of the aerosol layer varied for every measurement, compared with the stable stratospheric aerosol layer. Some tropospheric aerosol layers were confined by two inversion layers. Author

**A92-26874
A POSSIBLE INFLUENCE OF THE POLAR NIGHT
STRATOSPHERIC JET ON THE SUBTROPICAL
TROPOSPHERIC JET**

KUNIHICO KODERA, MASARU CHIBA, KOJI YAMAZAKI, and KIYOTAKA SHIBATA (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 715-721. Research supported by Science and Technology Agency of Japan. refs
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According to Nigam (1990), the first mode of his EOF analysis mainly represents variabilities in the zonal-mean zonal wind related to the displacement of the tropospheric subtropical jet. The present results of a lagged correlation analysis reveal that perturbations in zonal-mean zonal winds first occur in the stratosphere and then propagate into the subtropical troposphere. Numerical experiments with a general circulation model also indicate that the initial perturbations in the stratosphere can cause appreciable changes in the subtropical tropospheric jet. Author

**A92-26875
A NEW APPROACH FOR COUPLING A LIMITED AREA
MODEL TO A GCM FOR REGIONAL CLIMATE SIMULATIONS**

HIDEJI KIDA, TAKASHI KOIDE, HIDEAKA SASAKI, and MASARU CHIBA (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 69, Dec. 1991, p. 723-728. refs
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Consideration is given to a novel method for nesting a high-resolution limited area model (LAM) in a low-resolution GCM proposed for the purpose of conducting regional climate simulations. The concept of a spectral boundary in wavenumber space is the key to joining a high-resolution LAM to a low-resolution GCM. The present technique of combining two different resolution models is to replace the large-scale fields of the LAM with the corresponding large-scale fields supplied externally from the GCM at a selected regular time interval. It is shown that the time integration was very smooth over a period of one month, and that

the mesoscale features associated with the large-scale ones provided externally from the GCM were well simulated, suggesting that the new method is encouraging for regional mesoscale climate simulations. C.A.B.

**A92-27871
VARIATIONS AND DISTRIBUTIONS OF CO₂ IN AND OVER
THE EQUATORIAL PACIFIC DURING THE PERIOD FROM THE
1986/88 EL NINO EVENT TO THE 1988/89 LA NINA EVENT**

HISAYUKI Y. INOUE and YUKIO SUGIMURA (Meteorological Research Institute, Tsukuba, Japan) Tellus, Series B - Chemical and Physical Meteorology (ISSN 0280-6509), vol. 44B, Feb. 1992, p. 1-22. Research supported by Japan Meteorological Agency, Science and Technology Agency, and Environment Agency. refs
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Results are presented of measurements of CO₂ in and over the equatorial Pacific performed along with flask sampling of air during the period of the 1986/1988 El Nino/Southern Oscillation (ENSO) event to the 1988/1989 La Nina event. The pCO₂ of the equatorial Pacific was low during the 1986/1988 ENSO event but less dramatically than during the 1982/1983 ENSO event. On the basis of the relationship between the gas transfer coefficient and wind speed suggested by Takahashi et al. (1989), the equatorial Pacific CO₂ flux was estimated to be 0.4 Gt-C/yr in January and February 1987, and 1 Gt-C/yr in January and February 1989. The long-term trend of delta(C-13) and the concentration of atmospheric CO₂ indicate the predominant role of the biosphere (droughts and fire) for the atmospheric CO₂ increase between 1987 and 1988, and an important role of CO₂ exchange between the sea and the air between 1989 and 1988, as compared to the preceding year. P.D.

**A92-32105
PRECISION AND RELATIVE ACCURACY OF A PHASED
ARRAY DOPPLER SODAR**

MASATO TAKEHISA (All Nippon Airways Co., Ltd., Tokyo, Japan), YOSHIKI ITO (Kaijo Denki Co., Tokyo, Japan), and YASUSHI MITSUTA (Kyoto University, Uji, Japan) IN: Symposium on Meteorological Observations and Instrumentations, 7th, New Orleans, LA, Jan. 14-18, 1991, Preprints. Boston, MA, American Meteorological Society, 1991, p. 405-408. refs
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The paper describes a newly developed phased array Doppler wind-profiling sodar (AR-400) with 5 x 5 horns using 1400-Hz sound signal, together with the AR-400 specifications. The error terms of sodar observations were evaluated following the method of Strauch et al. (1987); the total errors of horizontal wind-velocity estimate were 0.35 m/s at 75 m and 0.60 m/s at 300 m for all periods in which the mean wind velocity was about 5 m/s. I.S.

**A92-34701
CHARACTERISTICS OF INTERNAL INERTIAL GRAVITY
WAVES AND INERTIAL WAVES IN THE LOWER
STRATOSPHERE OBSERVED BY THE MU RADAR**

SHINJI USHIMARU and HIROSHI TANAKA (Nagoya University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Feb. 1990, p. 1-18. Research supported by MOESC. refs
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Internal gravity waves in the upper troposphere and lower stratosphere are characterized using data from the MU radar observations carried out for five consecutive days in September 1985 and 1986. Propagation and origin of internal inertial gravity waves (IIGWs) and the inertial wave are discussed based on the wave parameters obtained from hodograph analysis and rotary spectral analyses in the vertical direction. Estimation results of the group velocity indicate that IIGWs are advected by the zonal mean wind and then the observed waves around a height of 17 km at the MU radar site are likely to have originated more than 1000 km west of the site. It is suggested that the inertial wave may have been propagated from the tropical upper troposphere over a period of about a week. IIGWs are characterized as quasi-monochromatic, and representative wave parameters include

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a horizontal scale of 200 km, a vertical wavelength of 1 to 2.5 km, a wave amplitude of several m/s, and a horizontal phase velocity of 3 m/s. O.G.

A92-34703

ON THE THERMAL INSTABILITY AND SIMILARITY IN NON-LINEAR HYDROSTATIC LAND-SEA BREEZE MODELS

HIROAKI KONDO (National Research Institute for Pollution and Resources, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Feb. 1990, p. 95-99. refs
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The similarities in the results from nonlinear land-sea breeze models are analyzed using the theory of thermal instability developed by Niino (1987) in conjunction with a simplified nonlinear land-sea breeze model. This theory contends that the critical value of the nonlinearity parameter, epsilon, at which thermal instability occurs is a unique value depending on the property of the fluid itself. However, numerical calculations indicate that the generation of the counter cell before the sea breeze front or convective cells over the land surface depends on at least three parameters, i.e., epsilon, the horizontal grid length, and horizontal diffusivity. The differences in the flow patterns are explained by the relationship between the estimated and critical Rayleigh numbers. When the Ra was close to the critical, disturbances occurred only near the sea breeze front. O.G.

A92-34704

LONG-TERM VARIATION OF UPPER STRATOSPHERIC CIRCULATION IN THE NORTHERN HEMISPHERE IN DECEMBER

KUNIHICO KODERA and KOJI YAMAZAKI (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Feb. 1990, p. 101-105. refs

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Long-term variation of the mean zonal wind in the upper stratosphere in December is investigated using NMC geopotential height data from 1979 to 1987. The period of analysis is anteriorly extended until 1973 by combining the results of various investigators. It was found that the mean zonal wind at 1 mb, 40 deg N shows outstanding long-term variation of the order of 10 years. Similar variation was also found in the rocket measurement of east-west wind component at R Yuri (39 deg N, 142 deg E). It is shown that the long-term variation of the mean zonal wind has a good correlation with the solar activity, ozone partial pressure and solar UV index. Author

A92-34705

NUMERICAL MODELING OF DYNAMICAL AND MICROPHYSICAL EVOLUTION OF AN ISOLATED CONVECTIVE CLOUD - THE 19 JULY 1981 CCOPE CLOUD

MASATAKA MURAKAMI (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 107-128. refs
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A 3D, anelastic cloud model for accurate simulation of the ice initiation and consequent precipitation growth is described and then verified by applying it to the simulation of the July 19, 1981 Cooperative Convective Precipitation Experiment (CCOPE). The model is based on the bulk water microphysical parameterization technique where number concentrations of cloud ice and snow are considered in addition to the mixing ratios of six water species (water vapor, cloud water, cloud ice, rain, snow, and graupel/hail). The model is capable of reproducing the general features of the cloud, including top height, cloud size, arrival time of precipitation at the cloud base. The model cloud also simulated quite well the location of hydrometeors with respect to the updraft/downdraft structure, the number concentration of precipitating ice particles, updraft velocity, and cloud water content along the King Air's penetrating pass. O.G.

A92-34706

VARIATION IN THE ATMOSPHERIC CIRCULATION OVER ASIA AND THE WESTERN PACIFIC ASSOCIATED WITH THE 40-DAY OSCILLATION OF THE INDIAN SUMMER MONSOON
NAOHIKO HIRASAWA and TETSUZO YASUNARI (Tsukuba, University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 129-143. refs
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A92-34708

PREDICTION OF 30-60 DAY OSCILLATION WITH THE JMA GLOBAL MODEL AND ITS IMPACT ON EXTENDED-RANGE FORECASTS

TADASHI TSUYUKI (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 183-201. refs
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The relationship between the eastward propagating 30-60 day modes in the tropics and the predictability of the Northern Hemisphere extratropical circulation have been investigated for the period of March 1988 - February 1989. The study used operational 15-day forecasts with the global prediction model of the Japan Meteorological Agency (JMA). The global model is capable of predicting the eastward-propagating 30-60 day modes both in amplitude and phase when they are significant in the observation. It is noted that the forecast skill of the 10-day mean 500 mb geopotential height north of 20 deg N for days 6-15 becomes relatively high in such cases during May-October. It is concluded that when the tropical 30-60 day oscillation is well predicted the skill of extended-range forecast for the Northern Hemisphere tends to increase due to a successful prediction of the influence of the 30-60 day modes on the extratropical circulation. O.G.

A92-34709

ON-BOARD DIRECT MEASUREMENTS OF TURBULENT FLUXES OVER THE OPEN SEA

OSAMU TSUKAMOTO, EIJI OHTAKI (Okayama University, Japan), HIROSHI ISHIDA (Kobe University of Mercantile Marine, Japan), MITSUAKI HORIGUCHI, and YASUSHI MITSUTA (Kyoto University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 203-211. refs
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Turbulent fluxes were determined by the eddy correlation method over the open sea area south of Japan, as part of WCRP/OMLET. Velocity components were corrected for the ship motions, and turbulent fluxes of momentum, heat, and water vapor were evaluated. It was almost neutral to slightly unstable, and the sensible heat fluxes were as small as 60 W/sq m while the latent heat fluxes showed a maximum value of about 200 W/sq m. Based on the direct measurements of turbulent fluxes, the bulk transfer coefficients were determined as $C(D) = 1.04 \times 10 \exp^{-3}$, $C(H) = 1.79 \times 10 \exp^{-3}$, and $C(E) = 0.94 \times 10 \exp^{-3}$ in the low wind speed region. The drag coefficient $C(D)$ increased with increasing mean wind speed, and the value is almost consistent with the previous studies. A notable difference is observed in the behaviors of $C(H)$ and $C(E)$, particularly in the high wind speed region. Author

A92-34712

THE DOUBLE-JET AND SEMI-ANNUAL OSCILLATIONS IN THE SOUTHERN HEMISPHERE SIMULATED BY THE METEOROLOGICAL RESEARCH INSTITUTE GENERAL CIRCULATION MODEL

AKIO KITOH, KOJI YAMAZAKI, and TATSUSHI TOKIOKA (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 251-264. refs
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The climatology of a 12-year integration with the Japan Meteorological Research Institute general circulation model (GCM) is described, and the results are compared with the observation for the period of 1979-1987. The model successfully reproduces

the major features typical of the Southern Hemisphere, which include the deep circumpolar trough during the entire year, the double jets in winter months, and the large semiannual component of sea-level pressure and zonal wind. The midtroposphere of the Southern Hemisphere is characterized by a mild sinusoidal temperature change at middle latitudes vs a larger trapezoidal temperature change over Antarctica, where there are a rapid cooling in early autumn, nearly constant temperature from April to October, and a rapid warming in November. The overall meridional temperature gradient between the middle latitudes and Antarctica is found to be the largest in the spring. A rapid cooling in autumn of the Antarctic lower troposphere, a coreless long winter, and the coldest atmosphere in early spring are considered to be crucial to a successful simulation of the winter double-jet structure and the semiannual oscillation in the Southern Hemisphere. O.G.

A92-34713**NONLINEAR NORMAL MODE INITIALIZATION FOR A SPECTRAL LIMITED-AREA MODEL**

ISAO TAKANO, HAJIME NAKAMURA, and YASUO TATSUMI (Japan Meteorological Agency, Ote) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 265-280. refs

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Consideration is given to the JMA spectral limited area models based on nonlinear normal mode initialization (NNMI) proposed by Machenhauer (1977). A constant map factor and Coriolis parameter are used to construct the normal modes of the models. The NNMI is aimed at preserving the prescribed boundary conditions of the model. Low-frequency gravity waves are excluded from the procedure by introducing a cut-off period. It is concluded that the large time tendencies of the gravity wave modes of the first five vertical modes are reduced through the initialization based on the adiabatic time tendencies. The changes of the initial states by the NNMI with a short six-hour cut-off period are found to be very small, while the NNMI with a longer cut-off period produced larger initial changes in the baroclinic zone. O.G.

A92-34714**ON THE DECREASE IN THE OCCURRENCE OF SYNOPTIC-SCALE TRANSIENT DISTURBANCES IN THE MIDDLE LATITUDES OF THE NORTHERN HEMISPHERE FOR THE PERIOD 1969-1979**

SHOICHI TAGUCHI (National Research Institute for Pollution and Resources, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, April 1990, p. 281-292. refs

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The occurrence of transient eddies having a time scale shorter than 10 days has been presented for the 850 mb and 500 mb height fields over a period of 11 years (1969 through 1979) for the Northern Hemisphere middle latitudes. The population of both cyclones and anticyclones contained in disturbances with a duration longer than three days decreased about 1.5 percent per year. The intensity of the disturbances also decreased during these years. The transport of sensible heat by transient eddies decreased while the total eddy transport of sensible heat remained unchanged. The relation between eddy heat flux and radiative forcing is discussed. Author

A92-34715**ANOTHER APPROACH ON LINEAR THEORY OF CONDITIONALLY UNSTABLE CONVECTION - A FORCING PROBLEM**

MASANORI YOSHIZAKI and ATSUSHI MORI (Tokyo, University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, June 1990, p. 327-334. Research supported by MOESC. refs

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A new approach is proposed to solve linear theory of conditionally unstable convection. In this study, the problem is considered to be a linear steady response of a stably stratified atmosphere to localized heating, where the growth rate is regarded as a Rayleigh damping/Newtonian cooling-type damping rate. This

problem of forced motion is linked to the convection problem when the horizontal distribution of the heating rate is required to be proportional to that of the upward motion. Thus, linear theory of conditionally unstable convection is reduced to a special case of the general problem of forced motion in a stably stratified atmosphere. From the standpoint of the forcing problem, the formation of the downward motion outside the unstable region is explained by the internal gravity waves propagating successively in the stably stratified atmosphere. Author

A92-34717**LAGRANGIAN-MEAN CIRCULATION AND WAVE-MEAN FLOW INTERACTIONS OF EADY'S BAROCLINIC INSTABILITY WAVES**

TOSHIKI IWASAKI (Japan Meteorological Agency, Tokyo) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, June 1990, p. 347-356. refs

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In order to comprehend the Lagrangian-mean circulations and wave-mean flow interactions in the midlatitude troposphere, the Eady baroclinic mode is examined using the transformed Eulerian-mean method in pressure-isentrope hybrid vertical coordinates proposed by Iwasaki (1989). The intersection of isentropes with an upper or lower boundary is shown to be essential for the formation of Lagrangian-mean circulation and wave-mean flow interactions of the Eady mode. The regions of isentropes intersecting the lower or upper boundary are called boundary isentrope layers. Based on the pressure and isentrope transformed Eulerian-mean, the linear Eady mode forms a direct circulation with poleward and equatorward flows in upper and lower boundary isentrope layers, respectively. The Eliassen Palm (EP) flux is converted from the Coriolis acceleration of mean flows within the lower boundary layer and absorbed in the mean flows within the upper boundary layer. Taking into consideration the beta effect (latitudinal variation of the Coriolis parameter), the poleward mean-meridional flows and EP flux convergence zones are expected to exist in the whole troposphere except for the lower boundary layer. Author

A92-34718**WEAKLY NON-LINEAR ASPECTS OF STEADY HYDROSTATIC MOUNTAIN WAVES IN A 2-LAYERED STRATIFIED FLUID OF INFINITE DEPTH OVER A 2-DIMENSIONAL MOUNTAIN**

MOTOHKI IKAWA (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, June 1990, p. 357-369. refs

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A92-34719**INTERNAL AND EXTERNAL CAUSES OF THE RECENT CLIMATIC CHANGE - A NUMERICAL STUDY WITH AN ENERGY BALANCE MODEL**

HIROYOSHI HATAZAWA and TATSUYA IWASHIMA (Kyoto University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, June 1990, p. 371-383. refs

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A92-34721**LOW-FREQUENCY VARIATIONS OF THE ZONAL MEAN STATE OF THE SOUTHERN HEMISPHERE TROPOSPHERE**

MASATO SHIOTANI (Kyoto University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Aug. 1990, p. 461-471. refs

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Low-frequency variation in the Southern Hemisphere troposphere has been studied using the global analyses for the 1980-1985 timeframe provided by the European Center for Medium Range Weather Forecasts. To capture the variation the zonal mean geopotential height is analyzed using an empirical orthogonal function (EOF). Four typical events, i.e., negative extreme (D-), positive extreme (D+), negative to positive transition (T+), and positive to negative transition (T-) events, are defined using time series of EOF coefficients, which represent the dominant

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nonseasonal low-frequency variation in the Southern Hemisphere. Composite analyses indicate that at 500 mb the latitudinal movement of maximum westerlies is quicker in T+ events than in T- events. The zonal mean temperature is colder at high latitudes and warmer at middle latitudes in D- events than in D+ events, which corresponds to the stronger polar vortex caused by the steeper temperature gradient and more vigorous storm activity in D- events than in D+ events. It is noted that the eddy momentum flux plays an important role especially during transition events.

O.G.

A92-34723

RAIN OBSERVATION BY AN X- AND KA-BAND DUAL-WAVELENGTH RADAR

KENJI NAKAMURA, HIDEYUKI INOMATA, TOSHIKI KOZU, JUN AWAKA, and KEN'ICHI OKAMOTO (Communications Research Laboratory, Koganei, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Oct. 1990, p. 509-521. refs Copyright

A rain observation by an X- and Ka-band dual-wavelength radar has been performed. The objective of this experiment is to explore the possibility of multiwavelength radar for measuring rainfall rate. Simultaneous rain observations by C- and Ku-band radars were also performed. Correlations among measured Z-factors show that rain attenuation is significant only in the Ka-band for a short range when the observing range is a few km. After a method of obtaining an optimum averaging hit number is proposed, a dual-wavelength analysis using rain attenuation is applied to Ka- and X-band radar data and the result confirms the capability of providing an estimation of rainfall rate other than that by the conventional method. The dual-wavelength analysis is compared with a single wavelength analysis using rain attenuation and an advantage of dual-wavelength analysis is verified. The capability of the dual-wavelength analysis for retrieving a vertical structure of rain is demonstrated. A radar calibration using the dual-wavelength analysis is tested and a more accurate calibration than that comparing the rain gauge data is obtained. Author

A92-34726

THE RELATIONSHIP OF SEA SURFACE TEMPERATURE AND WATER VAPOR AMOUNT TO CONVECTION OVER THE WESTERN TROPICAL PACIFIC REVEALED FROM SPLIT WINDOW MEASUREMENTS

TOSHIRO INOUE (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Oct. 1990, p. 589-606. Research supported by Science and Technology Agency of Japan. refs Copyright

Local correlations among convective activity, SST, and water vapor amount (WVA) are investigated over the western Pacific using only optically thick clouds objectively classified by the split window method as an index of the depth of convection. It is shown that the mean depth of convection is mostly correlated with WVA while convection becomes more active with increase of both SST and WVA. The convection depends slightly on SST for a fixed WVA, while convective activity is highly related to the increase of WVA at specific SST. Deep convection areas coincide with larger amounts of water vapor rather than warmer SSTs, and convectively suppressed areas over warmer SST areas are found to have smaller amounts of water vapor. For the same SST and WVA, the convection over a region where the intertropical convergence zone is dominant is less deep than that over the region where the south Pacific convergence zone prevails. C.D.

A92-34727

LONG-TERM SAHELIAN DROUGHT FROM THE LATE 1960'S TO THE MID-1980'S AND ITS RELATION TO THE ATMOSPHERIC CIRCULATION

MASATO SHINODA (Tokyo, University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 68, Oct. 1990, p. 613-624. refs (Contract MOESC-01790592) Copyright

A92-34891

ESTIMATION OF UPPER PRECIPITABLE WATER BASED ON THERMAL RADIATION OF WATER VAPOR ABSORPTION CHANNEL DATA

MASAO MATSUMOTO, SHIGEYUKI TAKASAKI, and KIYOSHI TSUCHIYA (Chiba University, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 189-192. Research supported by NASDA. refs Copyright

An attempt is made to estimate the precipitable water in upper troposphere based on MOS-1/VTIR water vapor absorption channel (6-7 micron) data. In the spectrum, the major part of the radiation reaching a satellite is the contribution from the thermal radiation in the upper troposphere. By dividing the atmosphere into two layers, an attempt is made to retrieve upper precipitable water profile as a maximum-likelihood solution of a linearized radiative transfer equation which represents the radiation conservation of the layered atmosphere. The estimated precipitable water in summer and winter shows a good correspondence with observed data. I.E.

A92-34959

DEVELOPMENT OF KEY DEVICES FOR TRMM RAIN RADAR

T. IHARA, K. OKAMOTO, T. KOZU, J. AWAKA, K. NAKAMURA, and M. FUJITA (Communications Research Laboratory, Koganei, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 513-516. refs Copyright

The Tropical Rainfall Measuring Mission (TRMM) is the first space mission dedicated to measurements of tropical rainfall, bearing the first radar in space. TRMM will enable quantitative measurements of rainfall over all land and ocean areas of the tropics. The results of the conceptual study of TRMM rain radar are presented, focusing on the characteristics of active array radar. The development status of key devices of TRMM rain radar is presented. I.E.

A92-35042

DEVELOPMENT OF A SPACEBORNE FOURIER TRANSFORM SPECTROMETER FOR GLOBAL ATMOSPHERIC MONITORING

HARUHISA SHIMODA (Tokai University, Tokyo, Japan), TOSHIHIRO OGAWA (Tokyo, University, Japan), MASAYASU HAYASHI (National Research Institute for Pollution and Resources, Tsukuba, Japan), AKIRA ONO (MITI, National Research Laboratory of Metrology, Tsukuba, Japan), AKIRA NISHINOMIYA (Central Research Institute of Electric Power Industry, Komae, Japan), SYOICHI HIRAI (Japan Resources Observation System Organization, Tokyo, Japan), and MAKOTO YOKOTA (MITI, Space Industry Div., Tokyo, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 931-934. Copyright

The Interferometric Monitor for Greenhouse Gases (IMG) is a spaceborne Fourier transform infrared spectrometer under development which is to be launched in 1995 on ADEOS (Advanced Earth Observation Satellite). It is a nadir viewing spectrometer with high spectral resolution (0.1/cm) observing a wide spectral range (3.3-14 microns). IMG is based upon the Michelson interferometer. It has three spectral bands (3.3-4.3 microns, 4.0-5.0 microns, and 4.0-14 microns), and each detector (InSb, InSb, HgCdTe) is cooled down to 80 K using a Sterling cycle cooler. IMG uses a magnetic bearing system for moving mirror scanning. The most accurate global distribution of atmospheric constituents (e.g., CO₂, H₂O, CH₄, N₂O, O₃, CO, etc.) will be measured by IMG. Further, acquired data will also be useful for earth radiation budget measurements, atmospheric correction for sea surface

temperature measurements, and other atmosphere related studies. I.E.

A92-35125

A NEW SIMPLIFIED METHOD FOR THE MEASUREMENT OF THE ATMOSPHERIC WATER VAPOR

SHINOBU HASHIMOTO (Oita-AIST Joint Research Center, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1329-1332. refs Copyright

A method is presented which is based on the measurement of the atmospheric extinction of solar radiation using a multifrequency Dicke radiometer and a set of two different beamwidth antennas. The relative intensity of the absorption spectrum is used as the measure of the water-vapor concentration. Problems associated with the conventional method, or cancellation of the thermal emission component of the atmosphere and the fluctuation of the solar radiation, can be removed automatically. Computer simulations for the estimation of the integrated water vapor and the altitude distribution are given in comparison with radiosonde data. I.E.

A92-35270

TYPHOON SIGNATURE ON TOMS DATA

FUMIHIKO HIRUMA, MANABU MATSUDA, KIYOSHI TSUCHIYA (Chiba University, Japan), MAKOTO SUZUKI, and NOBUO TAKEUCHI (National Institute for Environmental Studies, Tsukuba, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 2091-2094. refs Copyright

The TOMS total ozone from NIMBUS-7 is investigated with relation to typhoons from 1983 through 1989. The typhoon signatures on TOMS are classified into two groups. The first type is convex, i.e. the ozone concentration is high at the center. The second is concave i.e. the ozone concentration is low at the center. The two mechanisms are investigated by comparison with the ground weather map, upper atmospheric chart, and global meteorological objective grid data. I.E.

A92-37420

SOME GCM EXPERIMENTS OF THE ASIAN SUMMER MONSOON RELATED TO LAND BOUNDARY CONDITIONS

DODLA V. B. RAO, KOJI YAMAZAKI, and AKIO KITOH (Meteorological Research Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, no. 3, Sept. 1991, p. 127-143. Research supported by Science and Technology Agency of Japan. refs Copyright

The results of a 20-year simulation (control run) by the five layer MRI AGCM are analyzed for the Asian monsoon area for the summer season of June to September and are compared with the observations. The simulation with worldwide elevated topography illustrates the significant weakening of the monsoon circulation, although regional-scale features indicate an improvement. R.E.P.

A92-41378

SPECTRAL REFLECTANCE IN AN URBAN AREA - A CASE STUDY FOR TOKYO

TAMIO TAKAMURA (National Defense Academy, Yokosuka, Japan) Boundary-Layer Meteorology (ISSN 0006-8314), vol. 59, no. 1-2, April 1992, p. 67-82. refs Copyright

The spectral reflectance of the surface in an urbanized area was estimated through airborne measurements of the spectral upward flux of visible radiation in the range 475-750 nm. Atmospheric effects due to Rayleigh and Mie scattering were accounted for by using optical parameters to solve the radiative transfer equation. The values for these parameters were derived

from measurements of the particle number concentration and size distribution. The results clearly show a difference in reflectance between urban and suburban areas. The difference in spectral reflectance decreases from the suburban to the urban area. In a metropolitan area, the surface reflectance generally decreases with urban development, and the global upward flux of visible radiation has a similar tendency. This trend supports the idea of a decrease in reflectance due to the modification of the surface structure. Author

A92-41686

POSSIBLE EFFECT OF THE TROPOSPHERIC TEMPERATURE ON THE VARIATIONS IN THE MIDDLE ATMOSPHERE TEMPERATURE

KIYOTAKA SHIBATA (Meteorological Research Institute, Tsukuba, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 19, no. 10, May 22, 1992, p. 1001-1004. refs Copyright

The possible effect of the tropospheric temperatures on the variations in the middle atmosphere temperatures is investigated by calculating the radiatively determined temperature (RDT) anomalies corresponding to the observed tropospheric temperatures for 12 yr. The RDT anomalies relative to the observed standard deviations are less than 10 percent in the upper stratosphere and above, but 20-40 percent in the middle and lower stratosphere. The troposphere can therefore affect substantially the stratosphere through terrestrial radiation alone. The atmosphere around 70 hPa is found to be radiatively very sensitive to tropospheric conditions, because the RDT anomalies show extreme values there for large tropospheric anomalies. P.D.

A92-45805

VARIATIONS OF MEAN ZONAL WINDS RELATING TO THE OZONE HOLE

KOHJI KAWAHIRA (Toyama National College of Technology, Japan) and TOSHIHIKO HIROOKA (Japan Meteorological Agency, Meteorological College, Kasiwa, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. D9, June 20, 1992, p. 10,157-10,163. Research supported by MOESC. refs Copyright

Dynamical effects on the development of the Antarctic ozone hole are investigated through the analysis of the interannual variations of the monthly mean zonal winds in the Southern Hemisphere (SH) stratosphere using geopotential height data below and above 50 mbar and temperature data. It is found that the year-to-year changes of the mean zonal winds in the SH winter and spring in the lower stratosphere show no clear trends during the period from 1980 to 1988, in contrast to the ozone depletion and temperature decline. There are apparent differences in the zonal wind comparison between 1980s and the early 1970s which are cited from the model compiled by Barnett and Corney (1985). The differences in the Antarctic lower stratosphere in the winter and spring are evident in that the zonal winds poleward (equatorward) of 60 deg S become weaker (stronger) in the 1980s by over 10 m/s than in the early 1970s. On the other hand, the amplitudes of stationary waves of wavenumber 1 in the 1980s become weaker by about half of the amplitudes in the early 1970s. These results indicate that the dynamical condition appropriate for the development of the ozone hole, less poleward transport of heat and ozone by planetary waves, had been already present during the appearance of the ozone hole in about 1980 and still continues. Author

A92-47256

A NUMERICAL STUDY OF THE INTERACTION BETWEEN STATIONARY ROSSBY WAVES AND EASTWARD-TRAVELING WAVES IN THE SOUTHERN HEMISPHERE STRATOSPHERE

SHINJI USHIMARU and HIROSHI TANAKA (Nagoya University, Japan) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 49, no. 15, Aug. 1, 1992, p. 1354-1373. Research supported by MOESC. refs Copyright

A study is conducted on quasi-stationary Rossby waves with a

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wavenumber 1 component (wave 1) and eastward-traveling waves with a wavenumber 2 component (wave 2) which are frequently observed during the late winter and early spring in the Southern Hemisphere stratosphere. In particular, the periodic amplification of wave 1 is simulated using a mechanistic numerical model, and the mechanism of wave 1 amplification occurring during this period is investigated. The analysis of energetics showed that the amplification of wave 1 arises from the abrupt decrease of kinetic energy conversion to the zonal flow. The analysis of potential enstrophy conversion revealed that the amplification of wave 1 is caused by the wave-mean-flow interaction. I.S.

A92-47772

CLIMATOLOGY OF MESOSCALE WARM AND COLD FRONTS IN THE KANTO PLAIN

FUMIAKI FUJIBE (Meteorological Research Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 42, no. 4, Jan. 1992, p. 157-180. refs
Copyright

A statistical analysis is made of mesoscale warm fronts (MWFs) and mesoscale cold fronts (MCFs) in the Kanto plain by using hourly surface data covering eleven years. A series of objective criteria are used to select 190 MWFs and 177 MCFs, and composite analyses are made of their local structure, seasonal and diurnal variabilities, and the larger-scale environment. MWFs are associated with southeast-southwest winds or northwest winds blowing against a shallow cold-air pool having a depth of a few hundred meters. The MWF associated with southeast-southwest winds corresponds to the warm-air intrusion during the passage of a cyclone, while the MWF associated with northwest winds corresponds to a strong northwesterly surge. The frequency of MWFs is highest between 06 and 12 JST. The MCF generally occurs during a cold-air surge. From late autumn to winter, the MCF is mainly associated with northwest winds accompanied by shallow cold air in its leading edge, and is more frequent in the nighttime than in the daytime. From spring to summer, MCFs associated with northeast or east winds are more frequent than those associated with northwest winds, and have a strong tendency to occur in the afternoon. Author

A92-47955

DEVELOPMENT OF TOVS PROCESSING SYSTEM BASED ON A PHYSICAL METHOD IN MSC

YOSHIAKI TAKEUCHI (Meteorological Satellite Center, Technical Note (ISSN 0388-9653), no. 23, Nov. 1991, p. 37-69. In Japanese. refs

A retrieval algorithm based on a physical technique is developed for an operational TOVS system in MSC. The new algorithm is based on factors including the 12 hour forecast from the numerical prediction as the first guess. The forecast value is also utilized for the calculation of the weighting function and the sensitivity functions associated with the meteorological parameters. R.E.P.

A92-49633

MEDIUM-RANGE FORECAST SKILL VARIATION AND BLOCKING TRANSITION - A CASE STUDY

M. KIMOTO (Japan Meteorological Agency, Numerical Prediction Div., Tokyo), H. MUKOUGAWA (Japan Meteorological Agency, Meteorological College, Tokyo), and S. YODEN (Kyoto University, Japan) Monthly Weather Review (ISSN 0027-0644), vol. 120, no. 8, Aug. 1992, p. 1616-1627. Research supported by NOAA. refs

(Contract NSF ATM-86-15424; NSF ATM-90-13217; NOAA-NA-90ADMC076)

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Temporal variability in skill of operational medium-range forecasts in the winter of 1988/89 is examined. The primary concern is to examine the performance of the Japan Meteorological Agency global spectral model, which began daily 8-day forecasts in 1988. The model's forecast skill exhibits considerable low-frequency (about a week or longer) temporal variability. During the period under study, root-mean-square error (rmse) of 500-mb height showed a pronounced temporal maximum at the end of

January 1989, when the atmosphere over the North Pacific underwent a remarkable transition from zonal to blocked circulation. The consecutive forecasts during this period showed large dispersion among one another. A linear measure of forecast spread, or phase-space divergence of atmospheric trajectories, is also evaluated after Lorenz using a nondivergent barotropic model. It shows a temporal maximum concurrent with rmse. Therefore, it is likely that the zonal-to-blocking transition was associated with higher-than-average instability of the atmosphere. This impression is strengthened by the fact that the models at two other centers, the European Centre for Medium-Range Weather Forecasts and the U.S. National Meteorological Center, showed similar features. Author

A92-51585

SIMPLE CUMULUS MODELS IN ONE-DIMENSIONAL RADIATIVE CONVECTIVE EQUILIBRIUM PROBLEMS

MASAKI SATOH and YOSHI-YUKI HAYASHI (Tokyo, University, Japan) Journal of the Atmospheric Sciences (ISSN 0022-4928), vol. 49, no. 14, July 15, 1992, p. 1202-1220. refs
Copyright

The Lindzen et al. (1982) cumulus model for calculating 1D radiative convective equilibria is reexamined, and the behavior of the temperature profile of radiative convective equilibrium obtained by the model is investigated. Based on the Lindzen et al. model, a cumulus model is reconstructed by making careful distinction between the quantities in the regions of the upward and the downward motions. It is shown that an upper limit of the value of convective mass flux Mc exists above which the temperature in the region of upward motion is lower than that in the region of downward motion (i.e., the buoyancy is negative). Calculations of the greenhouse effect show that the dependency of Mc on the total optical thickness changes sign within the range of the observed dissipation rate. I.S.

A92-53403

MU RADAR OBSERVATIONS OF THE WIND FIELD IN THE VICINITY OF THE BAIU FRONT DURING EARLY JULY, 1987

P. T. MAY (Bureau of Meteorology, Research Centre, Melbourne, Australia), S. FUKAO (Kyoto University, Uji, Japan), P. J. NEIMAN (NOAA, Wave Propagation Laboratory, Boulder, CO), M. W. KOZLESKI (Cooperative Institute for Research in Environmental Sciences, Boulder, CO), M. D. YAMANAKA (Yamaguchi University, Japan), S. KATO, M. YAMAMOTO, T. SATO, and T. TSUDA (Kyoto University, Uji, Japan) Contributions to Atmospheric Physics/Beitraege zur Physik der Atmosphaere (ISSN 0005-8173), vol. 65, no. 1, Feb. 1992, p. 3-11. refs

Copyright

Observations of the wind field over Shigaraki, Japan during the Baiu season of 1987 are studied. These are the first observations of the Baiu front in the lower troposphere with the MU radar (46.5 MHz wind profiler). Conventional data as well as the MU radar data are used to discuss the observations in terms of large and medium scale structure of the front. The observations show a distinct layer of large vertical shear of the horizontal wind associated with the frontal zone through most of the troposphere. This is consistent with the description of the Baiu front as a deep baroclinic zone rather than being a shallow humidity front. A striking two layered structure of antiphased wind velocity variations associated with cyclonic waves along the front are observed in both wind components with the break in the structure occurring at about 5 km altitude. Author

A92-53725

TROPICAL RAINFALL MEASURING MISSION (TRMM)

KEN'ICHI OKAMOTO (Communications Research Laboratory, Koganei, Japan) and TASUKU TANAKA (NASDA, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1947-1952.

Copyright

The TRMM project is outlined. The TRMM will provide quantitative measurements of rainfall over all land and ocean areas

of the tropics. Tropical rainfall data are essential for understanding the global atmospheric structure, because tropical rain activity produces one of the major energy sources for the global atmospheric circulation. The major data product is monthly averaged rain rate over an area of 5×5 deg grid boxes between 37 deg N and 37 deg S for three-year mission life. To accomplish the objectives, the TRMM will carry three sensors to observe rain: AVHRR, microwave radiometers (ESMR,SSM/I), and a rain radar which will be the first spaceborne rain radar in history. The inclination of the satellite orbit will be 35 deg and the altitude will be 350 km, which is suitable to measure the tropical rain in detail. The data will be processed to provide various levels of products according to the processing level. Author

A92-53728* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

BIAS CORRECTION FOR RAINRATE RETRIEVALS FROM SATELLITE PASSIVE MICROWAVE SENSORS

DAVID A. SHORT (Communications Research Laboratory, Koganei, Japan; NASA, Goddard Space Flight Center, Greenbelt, MD) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1971-1976. refs
Copyright

Rainrates retrieved from past and present satellite-borne microwave sensors are affected by a fundamental remote sensing problem. Sensor fields-of-view are typically large enough to encompass substantial rainrate variability, whereas the retrieval algorithms, based on radiative transfer calculations, show a non-linear relationship between rainrate and microwave brightness temperature. Retrieved rainrates are systematically too low. A statistical model of the bias problem shows that bias correction factors depend on the probability distribution of instantaneous rainrate and on the average thickness of the rain layer. Author

**A92-54516
UTILIZATION OF THE 4 M MICROWAVE TELESCOPE FOR THE MEASUREMENT OF LIQUID WATER PATH IN CIRRUS CLOUDS**

RYOICHI IMASU (National Institute for Resources and Environment, Tsukuba, Japan) and YASUNOBU IWASAKI (Nagoya University, Toyokawa, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 70, no. 1, Feb. 1992, p. 123-129. refs
Copyright

The results of using a microwave telescope to measure the liquid water path of a cirrus cloud are presented and compared to data from a polarization lidar. Attention is given to an increasing feature attributed to liquid water path to ascertain whether the feature is related to changes in ice particles, water vapor, or temperature effects. The lidar observations confirm the presence of liquid water in the reflective regions of the cloud, and microwave radiometers are shown to aid in the measurement of liquid water path in clouds. C.C.S.

**A92-54517
GENERAL CIRCULATION DIAGNOSIS IN THE PRESSURE-ISENTROPE HYBRID VERTICAL COORDINATE**

TOSHIKI IWASAKI (Japan Meteorological Agency, Tokyo) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 70, no. 2, April 1992, p. 673-687. refs
(Contract NOAA-NA-88AANR0140)
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The role of baroclinic waves in the extratropical direct circulation is demonstrated by analyzing the mean meridional circulation and the wave-mean-flow interactions in the pressure-isentrope hybrid coordinate, using a general circulation model (NCAR CCM1). In this analysis, special attention is given to the seasonal variation of mean circulation and to its comparison between the Northern and the Southern Hemispheres. It is demonstrated that the present scheme adequately describes seasonal evolutions of the stratospheric circulation. I.S.

A92-54518

THE ANGLE OF DEFLECTION BETWEEN THE MEAN VECTOR OF THE SURFACE WIND AND THE GEOSTROPHIC WIND VECTOR OVER CENTRAL JAPAN

RIKIE SUZUKI (Tsukuba, University, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 70, no. 2, April 1992, p. 703-710. Research supported by University of Tsukuba. refs
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A92-54520

AN ANALYSIS SCHEME FOR TROPICAL WIND FIELDS BY THE THREE-DIMENSIONAL MASCON MODEL

YURIE HETA (Kyoto University, Uji, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 70, no. 3, June 1992, p. 783-788. refs
Copyright

For the analysis of the tropical wind fields, Heta (1990, 1991) applied the 2D Mass Consistent Atmospheric Flux (MASCON) model, which adjusts and smoothes the interpolated wind data to satisfy the continuity equation at the lower (850 hPa) level. However, the upper level (200 hPa) was evaluated only by interpolation. In the present paper, the analysis scheme of the 3D MASCON model is developed, that provides 3D wind fields (u, v, ω) over the whole troposphere in the tropical regions, using the variational calculus technique as the extension of the previous 2D model. By the use of this new scheme, the tropical wind fields surrounding the same tropical disturbances as the previous papers are reanalyzed, and the previous results are certified to be correct. Author

A92-54521

ZONALY SYMMETRIC DIURNAL TIDES SIMULATED WITH A GENERAL CIRCULATION MODEL

MASARU CHIBA and KIYOTAKA SHIBATA (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 70, no. 3, June 1992, p. 789-794. refs
Copyright

A large zonally symmetric diurnal variation is found in temperature and wind fields in a model general circulation of the middle atmosphere. This variation has a vertical wavelength of about 25 km and shows similar structures to those of the basic mode of zonally symmetric diurnal tides. The zonal component of diabatic heating projected to the horizontal structure function of this mode shows a prominent diurnal change with large amplitudes near the surface. The simulated zonally symmetric diurnal variation therefore is the basic mode of the upward propagating tides thermally excited in the lower troposphere, the amplitude of which mode becomes appreciably large in the middle atmosphere due to the density effect. Author

A92-54639

COMMON PHYSICAL PROCESSES IN NATURAL AND TRIGGERED LIGHTNING IN WINTER STORMS IN JAPAN

ZEN-ICHIRO KAWASAKI (Osaka University, Japan) and VLADISLAV MAZUR (NOAA, Environmental Research Laboratory, Norman, OK) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. D12, Aug. 20, 1992, p. 12,935-12,945. refs
Copyright

An analysis of measurements of electric, magnetic, and radiation field variations produced by rocket-triggered discharges in winter storms in Japan shows that a discharge initiated by a rocket with trailing and grounded wire is a negative leader that consists of continuous current and a pulse series associated with streamer development at the tip. The negative leader is not followed by a process analogous to a return stroke in cloud-to-ground flashes. Application of the electrostatic model of lightning as a bidirectional and uncharged leader in an ambient electric field to analysis of rocket-initiated discharges and positive cloud-to-ground flashes uncovers the commonality of processes occurring in both types of discharges. Author

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A92-55584

PRECIPITATION RADAR FOR TROPICAL RAINFALL MEASURING MISSION (TRMM)

HIDEO TAKAMATSU, MAKOTO KAJII, TOSHIKI KOZU, MASAHIRO KOJIMA (NASDA, Tokyo, Japan), and KEN'ICHI OKAMOTO (Communications Research Laboratory, Koganei, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p. refs (IAF PAPER 92-0097) Copyright

The characteristics and system parameters of the Precipitation Radar, one of the main instruments of the Tropical Rainfall Measurement Mission (TRMM) satellite, are described. The key PR technology is a 128-element active phased array system which achieves a quantitative rainfall measurement with high sensitivity and low sidelobe level by the electronic scanning technique. The PR scientific objective and major mission requirements are listed, and the history and status of the PR development are summarized. C.D.

A92-56000

TURBULENT TRANSPORT MECHANISM IN THE SURFACE LAYER OVER THE TROPICAL OCEAN

TOKUNOSUKE FUJITANI (Meteorological Research Institute, Tsukuba, Japan) Meteorological Society of Japan, Journal (ISSN 0026-1165), vol. 70, no. 4, Aug. 1992, p. 795-811. refs Copyright

The paper reports turbulent flux measurements by the eddy correlation method performed on board a ship in the tropical western Pacific during the summer MONEX field phase. The turbulent fluxes of momentum, sensible heat, and latent heat were estimated for three different stages: the disturbed period influenced by the ITCZ, the equatorial doldrums, and the undisturbed period. The sensible heat flux during the disturbed period was almost twice as large as that for the undisturbed period. C.A.B.

N92-19648# Meteorological Satellite Center, Tokyo (Japan).

METEOROLOGICAL SATELLITE CENTER TECHNICAL NOTE NO. 20, 1990

Mar. 1990 97 p In ENGLISH and JAPANESE Original contains color illustrations (ISSN 0388-9653)

(MSC-TN-20) Avail: CASI HC A05/MF A02

A collection of papers are presented which were of interest to the MSC. Some representative titles are as follows: a location algorithm of ARGOS data collection platform; evaluation and improvement of the accuracy of sea surface temperature derived from the operational processing of TOVS data; on enhancement displaying of GMS image; accuracy of the satellite-derived index of precipitation intensity and its representative characteristics; revised height assignment for high-level cloud motion winds derived from satellite imagery; and improvement of telemetry watching function.

N92-19652# Meteorological Satellite Center, Tokyo (Japan).

ACCURACY OF THE SATELLITE-DERIVED INDEX OF PRECIPITATION INTENSITY AND ITS REPRESENTATIVE CHARACTERISTICS

YOSHIYUKI ABE, IWAO NISHIMORI, HAJIME SENDA, and TAKAO IMAIZUMI In its Meteorological Satellite Center Technical Note No. 20, 1990 p 39-60 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A02

The satellite-derived index of precipitation intensity (SI) is the estimated value of precipitation intensity using satellite imagery data, and was produced operationally since 1 March 1989. The following three subjects were studied and clarified: (1) accuracy of the SI from June to September in 1989: (a) SI obtained by bi-spectrum (VIS & IR) method provides better accuracy than the one by monospectrum (IR) method, (b) accuracy of the SI depends significantly on the scale and type of disturbances, (c) high accuracy can be expected when Look Up Table (LUT) is applied to the same type of disturbances with a short time interval after the calculation of LUT, and (d) accuracy of the SI decreases when

LUT has not been updated for more than several hours; (2) representative characteristics of the SI obtained by IR method: (a) for an extratropical cyclone, the accuracy is generally reasonable, (b) for a typhoon, IR parameters (the mean and the deviation of T sub BB within 200 x 200 km box) does not provide reasonable accuracy because of multilayer cloud structure, and (c) the accuracy is generally reasonable when convective clouds are in the development stage; and (3) remaining issues for future improvement. Author

N92-19653# Meteorological Satellite Center, Tokyo (Japan). REVISED HEIGHT ASSIGNMENT FOR HIGH-LEVEL CLOUD MOTION WINDS DERIVED FROM SATELLITE IMAGERY

KEIJI DOI, HIROYUKI UCHIDA, and SHIGENORI NAITO In its Meteorological Satellite Center Technical Note No. 20, 1990 p 61-73 Mar. 1990 In JAPANESE; ENGLISH summary Avail: CASI HC A03/MF A02

In order to improve the accuracy of high level cloud motion wind (CMW) vectors derived from Geostationary Meteorological Satellite (GMS) imagery, two kinds of height assignment methods are examined. One is to calculate height for each tracer cloud using mean T sub BB of pixels above 400 mb. The height by means of this method is called Cloud Height by Temperature (CHT). The other is to revise the height assignment table currently in use in routine operations. The revised height table is statistically determined in every tens of degrees of latitudinal belt zones for every month, using vertical profiles of mean vector difference between CMW and RAWIN sonde data. The height from the revised table is called Wind Height from Table 90 (WHT90), and also the height from the old one is called WHT80. The results are as follows: the accuracy of CMW vectors both at CHT and at WHT90 is better than at WHT80; at CHT, CMW vectors are less accurate than at WHT80 where CMW vectors are in 10 deg N zone and in the equatorial zone and their speed are greater than 40 m/s; and some vectors at CHT have less accuracy than at WHT80 because of height estimation error caused by ambiguity of cloud emissivity. Author

N92-19665# Meteorological Satellite Center, Tokyo (Japan).

METEOROLOGICAL SATELLITE CENTER TECHNICAL NOTE, NO. 22, 1991

Mar. 1991 63 p In ENGLISH and JAPANESE Original contains color illustrations (ISSN 0388-9653)

(MSC-TN-22) Avail: CASI HC A04/MF A01

Topics of interest to the Meteorological Satellite Center are presented. Some representative titles are as follows: accuracy improvement of the satellite-derived index of precipitation intensity; on the relation between cumulus cloud lines and surface shear lines; analysis tool of GMS image on a work station; and a newly-developed technique of image mapping - distortion data determination based on the Earth edge detection from infrared half disc image.

N92-19666# Meteorological Satellite Center, Tokyo (Japan).

ACCURACY IMPROVEMENT OF THE SATELLITE-DERIVED INDEX OF PRECIPITATION INTENSITY

YOSHIYUKI ABE, IWAO NISHIMORI, YUZO YOTSUYA, and TEIICHI SUKAWA In its Meteorological Satellite Center Technical Note, no. 22, 1991 p 1-29 Mar. 1991 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A01

The Satellite-derived Index of Precipitation Intensity (SI) was produced operationally since 1 March 1989. The following was clarified and studied to improve the SI accuracy: (1) operated matters for improvement: (a) seasonal threshold values of radar beam height for radar echo composition were established as 4000 m for warm and cold season, (b) all digital radar data in Japan were composed, (c) Look Up Table (LUT) data (regression coefficients, magnification rate, bias, threshold TBB values) for the IR spectrum used in nighttime were calculated, and (d) constants for representative characteristics conversion (magnification rate, bias) were calculated by using the 1 percent

order value in radar intensity data; (2) monthly and hourly accuracy of the SI from Aug. to Dec. 1990: (a) mean correlation coefficient between radar intensity data and SI acquired by using the bi-spectrum method was 0.69 for all cases and 0.76 for cases only immediately after LUT data was updated, and (b) the SI acquired by using the bi-spectrum method provides better accuracy at midday than at early morning or evening; and (3) matters for future improvement: (a) new algorithm, (b) method using the LUT data, and (c) seasonal threshold TBB values for calculation of the LUT data.

Author

**N92-19667# Meteorological Satellite Center, Tokyo (Japan).
ON THE RELATION BETWEEN CUMULUS CLOUD LINES AND
SURFACE SHEAR LINES**

FUMIO UEDA *In its* Meteorological Satellite Center Technical Note, no. 22, 1991 p 31-39 Mar. 1991 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A01

The relationship between cumulus cloud lines and surface shear lines were studied. A surface shear line is connected to a Low Altitude Wind Shear (LAWS). LAWS is a phenomenon that affects the aircraft just on landing or takeoff. From an aviation point of view, the relationship between LAWS and cumulus cloud lines was to be studied, but because of insufficiency of the observation report of LAWS, the relation between shear lines and cumulus cloud lines was studied. The findings were as follows: (1) cloud lines can be classified into moving and stationary and into off the east and off the south coasts; (2) stationary cloud line east of Choshi does not correspond to surface shear line; (3) stationary cloud line off the south coast does not correspond to surface shear line that continues to inner land; (4) moving cloud line off the east coast corresponds to surface shear line - this cloud line is formed as a part of a comma-shaped cloud; and (5) cloud line moving off the south coast eastward with the cold front band does not correspond to surface shear line directly.

Author

**N92-19668# Meteorological Satellite Center, Tokyo (Japan).
ANALYSIS TOOL OF GMS IMAGE ON WORK STATION
RYOTA OHAMA and SHIGENORI NAITO *In its* Meteorological
Satellite Center Technical Note, no. 22, 1991 p 41-52 Mar.
1991 In JAPANESE; ENGLISH summary Original contains
color illustrations**

Avail: CASI HC A03/MF A01

An neph-analysis tool was developed on a work station. An analyst is able to analyze more detailed meso-scale phenomena, which will be the significant item of the next weather forecast service, using superimposition of geostationary meteorological satellite image and grid point value data with the aid of this software tool. Also, easy operation and applicability are performed by adapting X-window V.II system for image processing. The process of this tool is described and some typical examples of superimposition are shown.

Author

**N92-19669# Meteorological Satellite Center, Tokyo (Japan).
A NEWLY-DEVELOPED TECHNIQUE OF IMAGE MAPPING:
DISTORTION DATA DETERMINATION BASED ON THE EARTH
EDGE DETECTION FROM INFRARED HALF DISC IMAGE**

SEIICHIRO KIGAWA *In its* Meteorological Satellite Center Technical Note, no. 22, 1991 p 53-63 Mar. 1991 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A01

Image mapping makes each pixel of VISSR image data correspond to its position on the Earth. VISSR image data is absolutely necessary for use in image mapping. In order to improve the accuracy of the image mapping, MSC developed a fine tuning technique, called distortion data determination, based on the earth edge detection from infrared full disc image (Takahashi, 1981). This technique, however, can only be applied to full disc images and therefore its correction can not be reflected to WEFAX (Weather Facsimile Experiment) because of the broadcast time schedule. Moreover, the accuracy of the image mapping estimated from landmark matching data shows a seasonal variation (Kigawa, 1990). To solve these problems, a fine tuning technique of image

mapping using earth edge data of the northern hemisphere was developed. The accuracy of the newly developed technique estimated from landmark matching data is 140 micron radian and less. It will be possible to revise this technique with visible earth edge data.

Author

**N92-29686# Meteorological Satellite Center, Tokyo (Japan).
TAPERING CLOUDS AND THEIR CLASSIFICATION DUE
MAINLY TO THE SURROUNDING CLOUD PATTERN IN THE
GMS IMAGERY Technical Note No. 24**

HIDEKI ITOH, TADASHI ASOH, and MASAMI SAKURADA Mar. 1992 33 p In JAPANESE In ENGLISH and JAPANESE (ISSN 0388-9653)

Avail: CASI HC A03/MF A01

Active convective clouds developed into an elongated triangular pattern is called Tapering Cloud (later referred to as TC) owing to the cloud shape in the satellite imagery. TC is closely associated with severe weather, such as heavy rain, tornados, and so on. We investigated the meteorological conditions and sub-synoptical cloud pattern where TC is involved, with GMS-4 satellite imagery over one year. Main results from this survey are as follows: (1) TC evolves mostly over the sea and occurred largely around Sakisima Islands in the southern part of the East China Sea; (2) Latitudinal locations of TC occurrence show a seasonal variation; (3) On about 80 percent of TCs, life time is shorter than 10 hours; (4) Approximately 80 percent of TCs can be identified in the satellite imagery to have a Cu line extending windward from the point of elongated triangular TC; (5) According to the surface weather chart of JMA, approximately half of TCs evolve near the front and another half evolve in the warm sector; and (6) All TCs evolve in the ascending area on the 700 mb P-velocity map.

Author

**N92-31094*# Kyushu Univ., Fukuoka (Japan). Dept. of Electrical
Engineering.**

**ALEXANDRITE LIDAR FOR THE ATMOSPHERIC WATER
VAPOR DETECTION AND DEVELOPMENT OF POWERFUL
TUNABLE SOURCES IN IR**

M. UCHIUMI, M. MAEDA, K. MURAOKA, and O. UCHINO (Meteorological Research Inst., Tsukuba, Japan) *In* NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 683-686 Jul. 1992

Avail: CASI HC A01/MF A03

New tunable solid-state lasers, such as alexandrite and Ti-sapphire lasers, provide a powerful technique to detect various molecules in the atmosphere whose absorption bands are in the infrared region. The differential absorption lidar (DIAL) system to measure the tropospheric water vapor has been investigated by many authors, in an early stage, by dye and ruby lasers. Using the alpha band of water vapor, the longest detection range can be obtained with high accuracy, and the alexandrite laser is the most suitable laser for this purpose. In this paper, we describe the detection of water vapor in the atmosphere by an alexandrite lidar, and the development of powerful tunable sources based on Raman lasers in the infrared region.

Author

**N92-31104*# Ship Research Inst., Tokyo (Japan). Ship
Equipment and Marine Environment Div.**

LIDAR OBSERVATION OF MARINE MIXED LAYER

SUSUMU YAMAGISHI, HIROSHI YAMANOUCI, and MASAYUKI TSUCHIYA *In* NASA. Langley Research Center, 16th International Laser Radar Conference, Part 2 p 719-722 Jul. 1992

Avail: CASI HC A01/MF A03

Marine mixed layer is known to play an important role in the transportation of pollution exiting ship funnels. The application of a diffusion model is critically dependent upon a reliable estimate of a lid. However, the processes that form lids are not well understood, though considerable progress toward marine boundary layer has been achieved. This report describes observations of the marine mixed layer from the course Ise-wan to Nii-jima with the intention of gaining a better understanding of their structure by a shipboard lidar. These observations were made in the summer of 1991. One interesting feature of the observations was that the

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multiple layers of aerosols, which is rarely numerically modeled, was encountered. No attempt is yet made to present a systematic analysis of all the data collected. Instead we focus on observations that seem to be directly relevant to the structure of the mixed layer. Author

N92-70095 Meteorological Office, Bracknell (England).
A GUST FORECASTING METHOD BASED ON POWER SPECTRUM ANALYSIS

NORIHARU ISHII 1991 21 p Transl. into ENGLISH from Journal of Meteorological Research, Tokyo (Japan), v. 28, nos. 11-12, 1976 p 389-394

(BLL-MO-TRANS-1730(5733.360); TN-788) Avail: CASI HC A03

To find a means of predicting gusts over the runway of Shin Tokyo International Airport, 50 km ENE of Tokyo, a wind speed trace is analyzed for a 13 hr period over which mean speed was about 18 knots and wind direction was steady. The time change of wind speed is read off at 5 min intervals. From this, turbulent energy (E) is computed and then, by use of Longuet-Higgins' statistical method, some values of gust characteristics such as the peak gust in the forecast period, the wind speed range and the gust factor are computed on the basis of mean wind speed of the relevant period predicted from geostrophic approximation or prognostic charts. Predicted values agree well with observed values. Author

N92-70960 National Inst. of Polar Research, Tokyo (Japan).

**JARE DATA REPORTS. NO. 144 (METEOROLOGY 22),
ANTARCTIC CLIMATE RESEARCH DATA. PART 1:
RADIATION DATA AT SYOWA STATION, ANTARCTICA,
FEBRUARY 1987 - JANUARY 1988**

TAKASHI YAMANOUCHI, ed., TAKAO HOSHIAI, ed., MASAKI EJIRI, ed., KATSUTADA KAMINUMA, ed., IKUO KUSHIRO, ed., MASAYUKI TAKAHASHI, ed., OKITSUGU WATANABE, ed., TORAO YOSHIKAWA, ed., YOSHIYUKI FUJII, ed., TAKEO HIRASAWA, ed. et al. Mar. 1989 195 p (ISSN 0075-3343)

Avail: CASI HC A09

A five-year program of Antarctic Climate Research (ACR) was planned to be carried out at Syowa and Mizuho Stations, Asuka Camp and surrounding ice sheet and sea ice area from 1987 to 1991 by the Japanese Antarctic Research Expedition (JARE) as part of the international cooperating World Climate Research Program (WCRP). The main research subjects are: (1) interannual variation of Antarctic atmosphere; (2) sea ice-atmosphere interaction; (3) variation of ice sheet and ice shelf; and (4) ice core analysis. This volume contains the results of radiation measurements made at Syowa Station from February 11, 1987 to January 31, 1988 by JARE-28. Author

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OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

A92-21250

GROWTH OF WIND WAVES WITH FETCH OBSERVED BY THE GEOSAT ALTIMETER IN THE JAPAN SEA UNDER WINTER MONSOON

NAOTO EBUCHI, HIROSHI KAWAMURA, and YOSHIAKI TOBA (Tohoku University, Sendai, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, Jan. 15, 1992, p. 809-819. refs

(Contract MOESC-01646010; MOESC-01646013)

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The wind speeds and the significant wave heights derived from the Geosat altimeter are validated by comparing with the data obtained at Japanese ocean data buoy stations. A systematic error

is found in the altimeter wind speeds at high winds. An experimental equation is derived in order to correct this error for the present study. By using the corrected wind speeds and the wave heights, growth of wind waves with fetch in the Japan Sea under winter monsoon is investigated. The altimeter-derived nondimensional significant wave height and nondimensional fetch show good agreement with the empirical fetch graph formulas. Fetch variation of the wind speeds is also discussed in relation to the evolution of the turbulent boundary layer over wind waves by using the altimeter data. Author

A92-34882

THE POTENTIAL UTILITY OF LANDSAT-5 TM THERMAL INFRARED FOR PREDICTING SEASONAL SEA SURFACE TEMPERATURE OF OMURA BAY, NAGASAKI PREFECTURE, JAPAN

SAM WOUTHUYZEN, KEINOZUKE GOTOH, SHOJI IIZUKA (Nagasaki University, Japan), and SHIROH UNO (Seikai National Fisheries Research Institute, Nagasaki, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 149-152. refs

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A92-34886

ERROR CHARACTERISTICS OF SPLIT WINDOW FUNCTION FOR SEA SURFACE TEMPERATURE ESTIMATION

RYUZO YOKOYAMA and SUMIO TANBA (Iwate University, Morioka, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 167-170. refs

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Error statistics in the sea surface temperature (SST) estimation functions by the NOAA AVHRR (advanced very-high-resolution radiometer) brightness temperatures were investigated for two types of split window functions and a single variable function. The mean and the variance of the errors were described by the coefficients of the SST estimation function of the object and the statistics of the specified match-up data set used in the validation test. The authors investigate the statistics of the estimation error with regard to the coefficients of the estimation function and the match-up data statistics. The mean and the variance of errors in SST estimation functions are described in a unified manner. I.E.

A92-34887

AIR-SEA INTERACTING EFFECTS ON THE SEA SURFACE TEMPERATURE ESTIMATION

SUMIO TANBA and RYUZO YOKOYAMA (Iwate University, Morioka, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 171-174. refs

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A set of 390 match-ups of the NOAA-9 advanced very-high-resolution radiometer (AVHRR) brightness temperature and the sea surface temperature (SST) measured by buoys in Mutsu Bay were prepared. A split window function for the SST estimation was derived by applying regression analysis to the match-up data set. There appeared match-ups with rather large errors. By referring to meteorological records, errors appeared when there were large differences between the air temperature and the sea truth temperature. This result suggested the importance of sea surface effects in SST estimation. By removing those match-ups with larger errors from the original data set, a selected data set was prepared and provided the root mean of the squared errors of 0.32 C. I.E.

A92-35017

MOS-1 MULTI-SENSOR DATA SET FOR SEA ICE MONITORING - JAPANESE CONTRIBUTION TO ISY/PIE PROGRAM

K. CHO, K. TAKEDA (Remote Sensing Technology Center of Japan, Tokyo), F. NISHIO (Hokkaido University of Education, Kushiro, Japan), K. MAEDA, T. KODAMA (NASDA, Earth Observation Center, Hatoyama, Japan), and T. YAMANOUCHI (National Institute of Polar Research, Tokyo, Japan) IN: IGARSS '91; Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, Espoo, Finland, June 3-6, 1991. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 811-814. refs

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Japan's first polar orbiting earth observation satellite series, MOS-1 and MOS-1b, carry three different sensors, MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible Thermal Infrared Radiometer), and MSR (Microwave Scanning Radiometer). The advantage of MOS-1 is that it can observe the same phenomena using the three different sensors at the same time. In order to contribute to the ISY (International Space Year)/PIE (Polar Ice Extent) Program, NASDA and related agencies in Japan plan to produce an MOS-1 multisensor data set of the Antarctic region, Okhotsk Sea and the Arctic region. A description is given of the use of the data set for sea ice study and monitoring, and further plans to produce the MOS-1 data set for ISY/PIE.

I.E.

A92-48651

WORLD OCEAN CIRCULATION DIAGNOSTICALLY DERIVED FROM HYDROGRAPHIC AND WIND STRESS FIELDS. I - THE VELOCITY FIELD

SHINZOU FUJIO, TOSHIMITSU KADOWAKI, and NORIHISA IMASATO (Kyoto University, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. C7, July 15, 1992, p. 11,163-11,176. refs

(Contract MOESC-01610008; MOESC-02452059)

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The climatological annual mean fields of hydrographic data and wind stress are presently treated by a robust diagnostic model to yield the steady circulation of the world ocean, whose upper circulation reflects (1) the hydrographic data's surface geopotential anomaly, and (2) the 'warm water route' that passes westward through the Indonesian seas and across the Indian Ocean to the North Atlantic. A westward current that appears near 25 deg N in the middepth Atlantic is also noted. The Antarctic circumpolar current does not flow further northward even in the Madagascar Basin, due to the model's ignoring of large seasonal variations in the Indian Ocean.

O.C.

A92-48656

A FREE SURFACE GENERAL CIRCULATION MODEL FOR THE TROPICAL PACIFIC OCEAN

R.-H. ZHANG and M. ENDOH (Meteorological Research Institute, Tsukuba, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. C7, July 15, 1992, p. 11,237-11,255. Research supported by Science and Technology Agency of Japan. refs

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A free surface tropical ocean model has been developed which: (1) explicitly predicts the actual topography of the sea surface and other variables; (2) facilitates intercomparative studies among differently formulated oceanic general circulation models (OGCMs); and (3) data assimilation of the observed sea level. It is shown that, with the requisite treatments of the governing equations and numerical methods, the free surface baroclinic OGCM can be computed as least as efficiently as a rigid-lid model. The misrepresentation of energy conversion caused by the rigid-lid approximation is shown and estimated on the basis of the simulated data. The model reproduces both the observed current system and thermal structure and their variations, but also the sea level of the tropical Pacific.

O.C.

A92-48662

DOUBLE STRUCTURE OF THE COASTAL FRONT IN THE KII CHANNEL, JAPAN, DURING WINTER

TAKASHI TODA (Kyoto University, Japan) Journal of Geophysical

Research (ISSN 0148-0227), vol. 97, no. C7, July 15, 1992, p. 11,333-11,342. refs

(Contract MOESC-60420014; MOESC-60129032;

MOESC-61134039; MOESC-62124036)

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Upon analysis, satellite thermal imagery indicate that the coastal front in the Kii Channel has a double structure: an S-shaped front that is in a state of equilibrium, and a mouth front that is formed as a direct response to the intermittent arrival of warm water from the Kuroshio current. The western path of warm water circulation occurs less often than the eastern, but has a greater effect on the heat budget of the channel, and the shape of the front, than the eastern path. The tongue and outflowing structures due to the western path's formation of a large temperature difference are produced by water intruding across the mouth front. The tongue is a transient process toward the equilibrium of the S-shaped front.

O.C.

A92-49818

VERTICAL DISTRIBUTION OF DISSOLVED ORGANIC CARBON IN THE NORTH PACIFIC AS DETERMINED BY THE HIGH-TEMPERATURE CATALYTIC OXIDATION METHOD

EIICHIRO TANOUE (Meteorological Research Institute, Tsukuba, Japan) Earth and Planetary Science Letters (ISSN 0012-821X), vol. 111, no. 1, June 1992, p. 201-216. refs

(Contract MOESC-03248105)

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A92-52863

ROTATIONAL MODES FOR WARM AND COLD EDDIES

T. KAWANO and S. NAKAMOTO (Japan Marine Science and Technology Center, Yokosuka) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. C8, Aug. 15, 1992, p. 12,659-12,669. Research supported by Science and Technology Agency of Japan. refs

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Analytical solutions are found to describe a water parcel motion in both warm and cold eddies. An f plane, reduced gravity model, with upper layer thickness and velocity fields respectively Gaussian and linear in space, was reduced to the eight-dimensional system of nonlinear coupled ordinary differential equations which describe time evolution of differential kinematic parameters and eddy shape parameters. Analytical solutions for steady rotating modes for warm eddies and for cold eddies are discussed. For warm eddies the rigidly rotating ellipse mode solution corresponds to the 'rodon' solution for lenslike warm eddies. For cold eddies the corresponding rigidly rotating mode solution exhibits triangular path with abrupt direction change. Elliptical paths for warm eddies and triangular paths for cold eddies were observed in Western Pacific Ocean Circulation Study III drifter tracking data, which may be interpreted to be a possible manifestation of the rotating mode solutions predicted theoretically.

Author

A92-56624

WORLD OCEAN CIRCULATION DIAGNOSTICALLY DERIVED FROM HYDROGRAPHIC AND WIND STRESS FIELDS. II - THE WATER MOVEMENT

SHINZOU FUJIO, TOSHIMITSU KADOWAKI, and NORIHISA IMASATO (Kyoto University, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. C9, Sept. 15, 1992, p. 14,439-14,452. refs

(Contract MOESC-01610008; MOESC-02452059)

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The water movement in the world ocean is examined using a velocity field diagnostically derived from hydrographic and wind stress data. The movement of water is calculated numerically by tracking its constituent particles, and the attention is focused on where the water originates. The particle tracking indicates that deep water is formed not only in the North Atlantic and the Weddell Sea but also in the Ross Sea. The North Atlantic Deep Water contributes considerable volume to all the deep basins of the world ocean, while the Weddell Sea Deep Water (WSDW) tends to be confined to the southern region of the southern ocean.

Similarly, the Ross Sea Deep Water (RSDW) does not flow northward in the present model because the Antarctic Circumpolar Current (ACC) penetrates sufficiently deep to carry the RSDW away to the South Atlantic. It is also found that the WSDW does not mix directly with the Circumpolar Water because of the South Scotia Ridge, but rather mixes with the water recirculating in the Weddell Gyre, which is supplied by the middepth water of the ACD in the Atlantic-Indian Basin. Water composition in 16 basins is summarized in the form of box diagrams of deep water exchange.

Author

N92-16420 Canada Centre for Remote Sensing, Ottawa (Ontario).

SURFACE TEMPERATURES OBTAINED FROM THE VTIR SENSOR ABOARD THE JAPANESE MOS-1 SATELLITE
Abstract Only [LES TEMPERATURES DE SURFACE OBTENUES A PARTIR DU CAPTEUR VTIR DU SATELLITE JAPONAIS MOS-1]

MARIE-CATHERINE MOUCHOT and DANIEL A. DELISLE (INTERA Technologies Ltd., Ottawa, Ontario) In New Brunswick Univ., Proceedings of the Thirteenth Canadian Symposium on Remote Sensing p 325 Jul. 1990 In FRENCH

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, Ontario K2P 0J1 Canada

The observation of ocean surface temperatures through satellite borne infrared sensors has become an indispensable tool in the study of oceanographic phenomena. The NOAA series of meteorological satellites, with their advanced very high resolution radiometer (AVHRR) is one of the principle sources of infrared data on the ocean surface. By order of the availability of data, most applications developed by the Canada Centre for Remote Sensing use AVHRR data. The Japanese have developed a marine observation satellite (MOS-1). The characteristics of their visible and thermal infrared radiometer (VTIR) appear similar to those of the AVHRR. A study was undertaken to compare surface temperature acquired by VTIR with those acquired by AVHRR. Preliminary results demonstrate that temperatures obtained by the two sensors are correlated, even if the radiometric and spectral resolution of VTIR is weaker than that of AVHRR.

CISTI

N92-19650# Meteorological Satellite Center, Tokyo (Japan).
EVALUATION AND IMPROVEMENT OF THE ACCURACY OF SEA SURFACE TEMPERATURE DERIVED FROM THE OPERATIONAL PROCESSING OF TOVS DATA

YOSHIAKI TAKEUCHI and YOSHITO YOSHIZAKI In its Meteorological Satellite Center Technical Note No. 20, 1990 p 11-21 Mar. 1990 In JAPANESE; ENGLISH summary
 Avail: CASI HC A03/MF A02

The accuracy of Tiers Operational Vertical Sounder (TOVS) sea surface temperature products derived for TOVS data at MSC is estimated. It is found that large mean and root mean square errors at some areas are related to persistent error due to unsuitable objective analysis. To improve the accuracy of TOVS SST in regression, three approaches are studied: (1) the optimization of the number of channels for regression; (2) the quality check of classification data base; and (3) the change of scan-angle correction scheme. The results indicate that an increase or decrease in the number of channels used in regression does not have an effective impact on the accuracy, and that well-checked classification data base induce the improvement of the accuracy at the cost of the number of retrieved sea surface temperature.

Author

LIFE SCIENCES (GENERAL)

A92-18542

PLANETARY QUARANTINE IN THE SOLAR SYSTEM - SURVIVAL RATES OF SOME TERRESTRIAL ORGANISMS UNDER SIMULATED SPACE CONDITION BY PROTON IRRADIATION

J. KOIKE and T. OSHIMA (Tokyo Institute of Technology, Yokohama, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. Research supported by MOESC. refs

(IAF PAPER 91-542) Copyright

The survival rates of some species of terrestrial unicellular and multicellular organism (viruses, bacteria, yeasts, fungi, and algae) were studied under simulated interstellar conditions in connection with planetary quarantine. The interstellar environment in the solar system has been simulated by low temperature, high vacuum (77 K, 4×10^{-8} torr), and proton irradiation from a Van de Graaff generator. After exposure to a barrage of protons corresponding to about 250 years of irradiation in solar space, Tobacco mosaic virus, *Bacillus subtilis* spores, *Staphylococcus aureus*, *Micrococcus flavus*, *Aspergillus niger* spores, and *Clostridium manganeti* spores showed survival rates of 82, 45, 74, 13, 28, and 25 percent, respectively.

Author

A92-20859

TELESCIENCE TESTBED FOR BIOMEDICAL EXPERIMENTS IN SPACE MORPHOLOGICAL AND PHYSIOLOGICAL EXPERIMENTS OF RAT MUSCULOSKELETAL SYSTEM

SATORU WATANABE, MASAFUMI TANAKA (Nagoya University, Japan), YOSHIRO WADA (Nara Medical College, Japan), DAI YANAGIHARA, NAOYA TSUJIMOTO, HIDEKI SUZUKI, NORIYO KAWAI, SHUNJI NAGAOKA (Chukyo University, Toyota, Japan), MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), TAKATOSHI SHOJI (NASDA; Kawasaki Heavy Industries, Ltd., Kagami-hara, Japan) et al. (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 243-247. Research supported by MOESC. refs

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A92-20863

SPACE EXPERIMENT ON BEHAVIORS OF TREEFROG

AKEMI IZUMI-KUROTANI, MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and YUKISHIGE KAWASAKI (Mitsubishi Kasei Institute of Life Sciences, Machida, Japan) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 263-266.

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The paper describes the experimental system and the methods developed for observing the behavior of Japanese tree frogs (*Hyla japonica*), the species selected for space experiments aboard the MIR space station, under conditions of microgravity and under the effects of external stimuli. The system, which follows the same safety regulations as those applied for payloads on manned space vehicles, contains large number of instruments for passive observation and for observations of behavioral responses to various

stimuli, such as visual or mechanical, and during feeding or courtship. I.S.

A92-20887

MICRODOSIMETRIC CONSIDERATIONS OF EFFECTS OF HEAVY IONS ON E. COLI K-12 MUTANTS

T. TAKAHASHI, F. YATAGAI, and K. IZUMO (Riken Corp., Saitama, Japan) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 65-68. Research supported by Institute of Research and Innovation. refs Copyright

The inactivation cross sections of *E. coli* K-12 recombination-deficient mutants, JC1553 (*recA*) and AB2470 (*recB*), for several MeV/u alpha-particles and N ions have been successfully analyzed by Katz's target theory in which radiosensitivity parameter $E(0)$ is assumed to be LET independent and equal to D37 for gamma-rays. For *E. coli* K-12 wild type, AB1157 *rec(+)*, *uvr(+)*, however, it is impossible to interpret the inactivation cross-section data by an LET independent $E(0)$ -value. In the latter case, as in the case of *B. subtilis* spore, it is necessary to assume that the radiosensitivity of the target for the core of a heavy ion is higher than that for delta-electrons. Author

A92-20963

THE EFFECTS OF VACUUM-UV RADIATION (50-190 NM) ON MICROORGANISMS AND DNA

TAKASHI ITO (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 249-253. refs Copyright

Using a synchrotron as a radiation source, highly monochromatic UV light in the range 50-190 nm was used in vacuum to obtain action spectra for inactivation and mutation of two strains of *B. subtilis* spores. The two strains were different with respect to their repair ability: one was a FUV-sensitive (excision deficient) strain, and the other was an X-ray-sensitive (DNA-polymerase-I deficient) strain. Action spectra for DNA strand breaks were also measured in the same range, using isolated plasmid DNA. I.S.

A92-21480

EFFECT OF TAIL SUSPENSION ON CARDIOVASCULAR CONTROL IN RATS

HIDEFUMI WAKI, MASAMICHI SUDOH (Jikei University School of Medicine, Tokyo, Japan), and CHIHIRO NISHIMURA (Fukuoka University, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 28, June 1991, p. 39-50. refs

The effect of tail suspension on the cardiovascular control in rats was investigated by examining cardiovascular parameters in animals after a 10-day 20-deg or 45-deg head-down suspension (S) tests. Compared to the control group (0-deg S), 45-deg S resulted in increased falls of arterial-blood-pressure responses to the head-up tilt and LBNP. However, the carotid sinus baroreflex control of blood pressure was not attenuated by 45-deg S. The results suggest that the hemodynamic response patterns elicited in rats by a 10-day-long exposure to 45 S are similar to those associated with cardiovascular deconditioning induced by exposures to hypogravity. I.S.

A92-34194

NEUROVESTIBULAR PHYSIOLOGY IN FISH

SATORU WATANABE, AKIRA TAKABAYASHI, MASAFUMI TANAKA, and DAI YANAGIHARA (Nagoya University, Japan) IN: Advances in space biology and medicine. Vol. 1. Greenwich, CT,

JAI Press, Inc., 1991, p. 99-128. refs

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Results are presented from experiments on the behavior of fish in microgravity conditions. It is noted that, although the abnormal behavior of fish in weightlessness can be explained by the loss of the otolith function alone, the behavior exhibited by a labyrinthectomized fish in microgravity during a parabolic flight point to the role of other gravity sensors, such as the swimming bladder and the lateral line organs. Results of investigations of the dorsal light response (DLR) of fish in experiments involving the effects of the ablation of brain sections on the DLR indicated that the highest center operating in the visual-vestibular interaction in the DLR of the goldfish is the valvula cerebelli. Two hypotheses are proposed to explain the mechanism of the DLR: the tonus asymmetry principle and the telotactic principle of Von Holst. I.S.

A92-38116 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HYPERGRAVITY SIGNAL TRANSDUCTION IN HELA CELLS WITH CONCOMITANT PHOSPHORYLATION OF PROTEINS IMMUNOPRECIPITATED WITH

ANTI-MICROTUBULE-ASSOCIATED PROTEIN ANTIBODIES

YASUHIRO KUMEI (Tokyo Medical and Dental University, Japan), PEGGY A. WHITSON (NASA, Johnson Space Center, Houston, TX), ATSUSHIGE SATO (Tokyo Medical and Dental University, Japan), and NITZA M. CINTRON (NASA, Johnson Space Center, Houston, TX) Experimental Cell Research (ISSN 0014-4827), vol. 192, 1991, p. 492-496. Research supported by NASA. refs Copyright

It is shown that hypergravity (35g) stimulates the production of inositol 1,4,5-trisphosphate (IP3) and decreases adenosine 3-prime,5-prime-cyclic monophosphate (cAMP) levels in HeLa cells. It is proposed that IP3 and cAMP may act as second messengers in hypergravity signal transduction. Phosphorylation of microtubule-associated proteins in both the detergent-soluble and -insoluble fractions suggests that cytoskeletal structures may be influenced by gravity. P.D.

A92-39155

EFFECT OF LONG-TERM HINDLIMB SUSPENSION ON BLOOD COMPONENTS

MASAYUKI NAKAYA, KAZUO KOSUGI, and SHUJI TAKEUCHI (Jikei University, Tokyo, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-92, S-93. refs

The effect of microgravity on the contents in blood of various blood components was investigated in rats subjected to 10-week-long tail suspension. Results showed that long-duration tail-suspension resulted in significant decreases in the contents of blood albumin, uric acid, and triglyceride and in increased content of creatine kinase. The anemia observed in tail-suspended rats resembled symptoms of sideroblastic anemia and was different from the type of anemia observed in astronauts. I.S.

A92-45817

EFFECT OF HYPOBARIC HYPOXIA ON FIBER TYPE COMPOSITION OF THE SOLEUS MUSCLE IN THE DEVELOPING RAT

M. ITOH, K. ITOH, S. TAGUCHI, C. HIROFUJI, H. TAKEUCHI, and A. ISHIHARA (Kyoto University, Japan) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 7, July 1992, p. 583-587. refs

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The fiber type composition of the soleus muscle was investigated in male Sprague-Dawley rats exposed to hypobaric hypoxia of 460 mm Hg from 5 to 12 weeks of age. The muscle fibers were classified as fast-twitch oxidative (FO) and slow-twitch (S) on the basis of adenosine triphosphatase (ATPase) and succinate dehydrogenase (SDH) reactions. Intermediate fibers (INT) with intermediate ATPase and high SDH reaction intensities were

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also examined. A type shift of muscle fibers from FO to INT and S was found in the control group during development. After exposure to hypoxia, the hypoxia group had a significantly greater percentage of FO fibers than the age-matched control group. There was no significant change in the total number of fibers in the muscle during development and after exposure to hypoxia. These results indicate that the increased percentage of FO fibers found in the developing rat under hypoxic conditions is due to a hypoxia-induced inhibition of the type shift of muscle fibers from FO to S during development. Author

A92-50176

TELESCIENCE TESTBED - OPERATIONAL SUPPORT FUNCTIONS FOR BIOMEDICAL EXPERIMENTS

MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), SATORU WATANABE (Nagoya University, Japan), TAKATOSHI SHOJI (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), ANDREW H. CLARKE (Berlin, Freie Universitaet, HNO Klinik, Federal Republic of Germany), HIROYUKI SUZUKI (Nagoya University, Japan), and DAI YANAGIHARA (Chukyo University, Toyota, Japan) (Living and working in space; IAA Man in Space Symposium, 9th, Cologne, Federal Republic of Germany, June 17-21, 1991, Selection of Papers. A92-50151 21-54) Acta Astronautica (ISSN 0094-5765), vol. 27, July 1992, p. 155-161. refs

Copyright

A telescience testbed was conducted to study the methodology of space biomedicine with simulated constraints imposed on space experiments. An experimental subject selected for this testbedding was an elaborate surgery of animals and electrophysiological measurements conducted by an operator onboard. The standing potential in the ampulla of the pigeon's semicircular canal was measured during gravitational and caloric stimulation. A principal investigator, isolated from the operation site, participated in the experiment interactively by telecommunication links. Reliability analysis was applied to the whole layers of experimentation, including design of experimental objectives and operational procedures. Engineering and technological aspects of telescience are discussed in terms of reliability to assure quality of science. Feasibility of robotics was examined for supportive functions to reduce the workload of the onboard operator. Author

A92-53003

ADAPTATION AND ITS LIMITATIONS IN EXTREME ENVIRONMENTS - THE CASE OF A COLD ENVIRONMENT

AKIHIRO KUROSHIMA (Asahikawa Medical College, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 29, no. 1, March 1992, p. 22-25. In Japanese. refs

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Hypothermia and physiological functional changes of the human body in cold environments are considered. The cold adaptation conditions are examined, and the relationship between ambient temperature and metabolic rate is analyzed. The difference between ambient and rectal temperature for different species is discussed. Y.P.Q.

A92-53735

POSTURE CONTROL OF GOLDFISH IN MICROGRAVITY

AKIRA TAKABAYASHI (Fujita Health University, Japan), SATORU WATANABE, SHIGEO MORI, MASAFUMI TANAKA, SOUKITI SAKURAGI, and SADAHARU TAKAGI (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2015-2020. refs

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Unilaterally labyrinthectomized (ULT) and bilaterally labyrinthectomized (BLT) goldfish which were adapted under a 1 G environment for 43 weeks after a surgical operation were flown in an aircraft so that dorsal light response (DLR) in microgravity could be observed. Maximum tilt angle and tilt speed of DLR measured by changing the illumination from the top to the side, which were increased just after the operation in both ULT and

BLT fish, gradually decreased and reached to a steady level which was not identical to that of normal fish. In microgravity, however, the maximum tilt angle and tilt speed increased and there were no significant differences among the normal, ULT, and BLT fish. These results suggest that not only visual and vestibular input but also other sensory input may play some role in the DLR under 1 G conditions, and visual input may be the most important to control posture in microgravity. Author

A92-53736

TELESCIENCE TESTBED FOR BIOMEDICAL EXPERIMENT IN SPACE - OPERATIONAL MANAGERMENTS

MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), TAKATOSHI SHOJI (Kawasaki Heavy Industries, Ltd., Technical Institute, Akashi, Japan), HIDEO SUDOH (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), TAKEHISA MATSUMOTO (NASDA, Tokyo, Japan), FLEMMING BONDE-PETERSEN (Danish Aerospace Medical Centre of Research, Copenhagen, Denmark), and SATORU WATANABE (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2021-2030. refs

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'Telescience', which allows investigators to conduct space biomedical experiments from suitably 'teletool-equipped' ground stations, is presently implemented in a testbed which simulates the influence of a telescience system on the results of scientific studies. An effort is made to refine the simulated methods in view of the results thus obtained. The testbed experiments give attention to blood samples, muscle biopsies, and operations for the embedding of a sensor and the collection of specimen muscle tissue. O.C.

A92-53737

THE CARDIAC RESPONSES OF MONKEYS EXPOSED TO CENTRIFUGAL ACCELERATION

HIROTAKA SATAKE and KEN'ICHIRO MATSUNAMI (Gifu University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2037-2040. refs

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The cardiac system effects of positive and negative centrifugal acceleration were studied in three anesthetized monkeys every two weeks for 2-3 months. When the cardiac responses of intact monkeys are compared with those of bilaterally labyrinthectomized ones, striking differences are observed in $+g(z)$ but not $-g(x)$ exposure. It appears that the vestibuloautonomic reflex modulates responses in heart rate, perhaps through the activation of the sympathetic nerve. The vestibuloautonomic reflex may have assisted the cardiovascular reflex. O.C.

A92-53738

THE EFFECT OF ENDURANCE EXERCISE ON SUSPENSION-INDUCED ATROPHY OF RAT SLOW AND FAST SKELETAL MUSCLE FIBERS

TOSHITADA YOSHIOKA, KATSUMASA YAMASHITA, HIROYOSHI KASUGAI, KUNIYUKI SHIMIZU (St. Marianna University, Kawasaki, Japan), and HIROAKI TAKEKURA (National Institute of Fitness and Sports, Kagoshima, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2041-2045. refs

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In order to prevent degenerative alterations in structural and functional properties of skeletal muscle fiber resulting from experimental hypogravity rats, were forced to exercise by endurance running training before exposure to hypogravity. There was no significant difference in glycolytic enzyme activity among slow-twitch oxidative, fast-twitch oxidative and glycolytic, and fast-twitch glycolytic fibers whether after endurance training or in the suspension groups. On the other hand, the activity of oxidative

enzyme decreased in fast-twitch oxidative and glycolytic and fast-twitch glycolytic fibers following hindlimb suspension hypokinesia but increased in all types of fiber after endurance exercise. A recovery in oxidative capacity was shown in previously trained muscle fiber even after exposure to hypogravity conditions. The mitochondrial volume analyzed by a point-counting method did not decrease in response to suspension in the previously trained muscle, although it decreased in muscle in the suspension-only group. Lipid droplet volume did not show the same trend. The results indicate that the skeletal muscle trained by a proper protocol of endurance exercise could maintain functional and structural properties even after exposure to hypogravity conditions. Author

A92-53743

ABIOTIC SYNTHESIS OF AMINO ACIDS AND NUCLEIC ACID BASES SIMULATING AN ACTION OF COSMIC RADIATION

KENSEI KOBAYASHI, TAKEO KANEKO, MASAHIKO TSUCHIYA (Yokohama National University, Japan), TAIRO OSHIMA (Tokyo Institute of Technology, Japan), HIROSHI YANAGAWA (Mitsubishi Kasei Institute of Life Sciences, Tokyo, Japan), and TAKESHI SAITO (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2071-2076. refs
Copyright

Proton irradiation of simulated primitive earth atmospheres was performed to study the roles of cosmic radiation in chemical evolution. A mixture of carbon monoxide and nitrogen over water was irradiated by high energy protons (3 MeV, 0.6 micro-A) generated by a Van de Graaff accelerator. Various kinds of compounds of biological importance were identified in the product, including proteinous amino acids, imidazole, purines, and pyrimidines. The present results suggest that compounds of biological importance could have been synthesized on the primitive earth and in extraterrestrial environments by radiation of cosmic rays and/or solar flare particles. Author

A92-53744

CAN TERRESTRIAL MICROORGANISMS SURVIVE IN INTERSTELLAR ENVIRONMENT?

JUNPEI KOIKE and TAIRO OSHIMA (Tokyo Institute of Technology, Nagatsuta, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2077-2081. refs
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In connection with planetary quarantine, the survival rates of eight species of terrestrial microorganisms (virus, bacteria, yeast and fungi) under simulated interstellar conditions are investigated. If common terrestrial microorganisms cannot survive in space even for a short period, the cost of sterilizing space probes can be greatly reduced. The interstellar environment has been simulated by using an ultra-low temperature-high vacuum (77K, 4×10^{-6} torr) and proton irradiation from a Van de Graaff generator. After exposing a barrage of the protons corresponding to about 250 years irradiation in space, it was shown that Tobacco mosaic virus, *Bacillus subtilis* (spores), *Aspergillus niger* (spores) and *Clostridium manganeti* (spores) survived at rates of 82 percent, 45 percent, 28 percent and 25 percent, respectively. Author

A92-53745*

National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

RAPID INCREASE OF INOSITOL 1,4,5-TRISPHOSPHATE IN THE HELA CELLS AFTER HYPERGRAVITY EXPOSURE

YASUHIRO KUMEI (Tokyo Medical and Dental University, Japan), PEGGY A. WHITSON, NITZA M. CINTRON (NASA, Johnson Space Center, Houston, TX), and ATSUSHIGE SATO (Tokyo Medical and Dental University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2083-2085. refs
Copyright

The IP3 level in HeLa cells has been elevated through the

application in hypergravity in a time-dependent manner. The data obtained for the hydrolytic products of PIP2, IP3, and DG are noted to modulate c-myc gene expression. It is also established that the cAMP accumulation by the IBMX in hypergravity-exposed cells was suppressed relative to the control. In light of IP3 increase and cAMP decrease results, a single GTP-binding protein may play a role in the hypergravity signal transduction of HeLa cells by stimulating PLC while inhibiting adenylate cyclase. O.C.

A92-53746

BEHAVIORAL RESPONSES OF PARAMECIUM TO GRAVITY

AKIRA MURAKAMI and KEIICHI TAKAHASHI (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2087-2089. refs
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The swimming behavior of *Paramecium* was recorded and analyzed under various gravitational conditions. The responses to hypergravity were investigated using a centrifuge microscope. When centrifuged, the paramecia were gradually oriented parallel or antiparallel to the direction of the centrifugal force. Paramecia that had been centrifuged shortly before were more rapidly oriented than those without the precentrifugation, as long as the centrifugal force was above 70 g. A gravitational acceleration of 1 g is not enough to induce gravitactic orientation by the mechanism suggested by the 'physical hypothesis' of geotaxis. Analyses of the swimming tracks of paramecia under 1 g indicated that the negative gravitactic behavior was caused by upward orientation of the swimming organisms. The swimming behavior of paramecia during a free fall was recorded using the 18 m drop facility in Bremen. The results suggest that a physiological mechanism is involved in the response of *Paramecium* to microgravity. Author

A92-53747

OBSERVATION OF BEHAVIOR OF TREEFROGS IN SPACE

AKEMI IZUMI-KUROTANI, MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and ATSUSHI OKETA (Tokyo Broadcasting System, Inc., Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2091-2095.
Copyright

The Russian space station Mir will use Japanese treefrogs for experimental observations of microgravity effects on their behavior under various stimuli. Experimental system verification trials will give attention to the mechanical and gaseous media environment, materials selection, and biological contamination for the experiment's life-support box, frog observation system, and frog recovery box. O.C.

A92-53748

DEVELOPMENT OF CLOSED RESEARCH ANIMAL HOLDING FACILITY (CRAHF) FOR SPACE STATION - LONG-TERM

(THREE MONTH) ANIMAL-FEEDING EXPERIMENT WITH BBM TADASHI UEDA, HIDEO SUDOH, HIROBUMI YAMADA (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), TAKATOSHI SHOJI, SHUICHIRO HATAKEYAMA (Kawasaki Heavy Industries, Ltd., Akashi Technical Institute, Japan), SATORU WATANABE, MITURO KIDA, MASAFUMI TANAKA, SADA HARU TAKAGI (Nagoya University, Japan), and MAKOTO OKANO (Kawajuu Gifu Engineering, Ltd., Kakamigahara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2097-2106. refs
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In preparation for animal experiments in Space Station, animal-feeding experiments have been conducted using the fully-closed CRAHF breadboard models (ground-based facility) for 5 years. Based on a trend analysis of data obtained from an experiment of 3 consecutive months, in addition to 1- and 2-month experiments previously conducted, it is concluded that long-term animal experiments exceeding 3 months are possible with the

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CRAHF. Future prospects for animal experimentation with the CRAHF in the Space Station are reviewed. Author

A92-53750

SPACE BIOLOGY EXPERIMENT SYSTEM FOR SFU

T. KIMURA, M. TAKAYANAGI, Y. ZAIKI, S. KITAMURA (Fujitsu, Ltd., Space Development Promotion Group, Kawasaki, Japan), S. KOMADA (Fujitsu, Ltd., Mechatronics in Space Laboratory, Kawasaki, Japan), A. IZUMI-KUROTANI, and M. YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2113-2117. Research supported by Institute of Space and Astronautical Science. refs Copyright

The Japanese Space Flyer Unit (SFU) will carry two biological experiments, one of which involves female newts and the other the eggs of a small fresh-water fish. Each of the SFU's two experimental units employs a control system and a power supply. Specimen behavior is monitored by a CCD camera. This experiment design yields maximum performance with minimum resources, and is scheduled for H-II booster launch aboard the SFU in 1994.

O.C.

A92-53766

DEVELOPMENT OF SAMPLE HANDLING SUBSYSTEM FOR SPACE BORNE ELECTROPHORESIS FACILITY

YUSUKE TAKAGI, KENJI MITANI, NOBUO HAMANO (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), YOSHIO KOJIMA, TSUTOMU OKUSAWA, and KUNIYOSHI TSUBOUCHI (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2225-2229. refs Copyright

The Electrophoresis Facility (EPF) for space use necessitates a suitable Sample Handling Subsystem (SHS) for space experiment to separate and purify biosamples. To meet this requirement, a new type of SHS has been developed. The subsystem stores and exchanges multiple biosamples using sample vessels and fluid valves which utilize freeze/thaw principle. This subsystem satisfies various demands for space such as low microgravity disturbance, restriction on mass, volume and power consumption, and low level biocontamination, as well as enables the automated operation of EPF.

Author

A92-53768

DEVELOPMENT OF AN ELECTROMAGNETIC DEGASSER OF BIOTECHNOLOGY DEVICES IN MICROGRAVITY

TSUTOMU OKUSAWA, KUNIYOSHI TSUBOUCHI, YOSHIO KOJIMA (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Japan), NOBUO HAMANO, YUSUKE TAKAGI, and KENJI MITANI (Hitachi, Ltd., Space System Div., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2237-2241. Copyright

The degassing of microgravity biotechnology experiments is presently approached by novel means involving a vacuum chamber, magnets, and a tubular hydrophobic membrane. The experimental results obtained with this device show that gas can be removed from a two-phase (gas-liquid) flow without buoyancy support. The electromagnetic field generated by the device furnished higher separation effectiveness than the conventional degassing system that employs vacuum and a separation membrane alone.

O.C.

N92-23629*# National Space Development Agency, Tokyo (Japan).

RADIATION MONITORING CONTAINER DEVICE (16-IML-1)

S. NAGAOKA IN NASA. Marshall Space Flight Center, First International Microgravity Laboratory Experiment Descriptions p 189 Feb. 1992

Avail: CASI HC A01/MF A03

In this experiment, layers of radiation detectors and biological specimens, bacterial spores (*Bacillus subtilis*), shrimp eggs (*Attemia salina*), and maize seeds (*Zea mays*) are sandwiched together in the Radiation Monitoring Container. The detectors, sheets of plastic materials, record the nuclear track of cosmic radiation. The dosimeter package contains conventional detectors made of materials such as lithium fluoride or magnesium-silica-terbium. The thermoluminescent materials (TLD) will, when moderately heated, emit luminescent photons linearly depending upon the dose of radiation received. The experiment, enclosed in a box-like container, is mounted on the aft end cone of the Spacelab, the area where the shielding is somewhat less than other locations.

Author

N92-33863# Nagoya Univ. (Japan). Dept. of Aerospace Physiology.

RESULT OF AIRCRAFT EXPERIMENTS

SATORU WATANABE IN Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 141-146 21 Jan. 1992 IN JAPANESE

Avail: CASI HC A02/MF A02

Airborne experiments were conducted on biological system phenomena under microgravity conditions. The effect of gravity change on the vestibular apparatus in goldfish was examined. Negative reaction to light, in microgravity conditions, was also examined. One fish had its vestibular apparatus removed and the other did not. The latter always swam with its back directed upward (0 deg) when illuminated from above, but it swam with its back directed at an angle (20 to 30 deg) when illuminated from the side (90 deg). The former laid down with its back directed toward the light. Normal goldfish took an attitude called diving response (head down) in microgravity, but diving response was not observed in the fish that had undergone removal of the vestibular apparatus. Fish which returned to normal swimming after the operation showed diving response, though they had no vestibular apparatus, making it clear that diving response is not caused by said organ.

Author (NASDA)

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A92-15952

HORMONAL RESPONSES OF PILOTS FLYING HIGH-PERFORMANCE AIRCRAFT DURING SEVEN REPETITIVE FLIGHT MISSIONS

H. TARUI and A. NAKAMURA (Japan Air Self Defense Force, Aeromedical Laboratory, Tokyo) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1127-1131. refs

Copyright

Hormonal responses during seven repetitive flight missions (7RFM) were evaluated on F-4EJ fighter pilots. The following biochemical constituents were measured: (1) cortisol in saliva; (2) 17-OHCS; (3) unbound cortisol; (4) catecholamines in urine; and (5) electrolytes in urine. Samples were collected at about 30 min before the mission, 20 min after each flight, and in a nonflight day for control. The levels of saliva and urine corticosteroids slightly increased during 7RFM when compared with controls. The concentrations of urine catecholamines during 7RFM were significantly higher than those of preflight and control. These data suggest that flight stresses were moderate for the pilots flying 7RFM.

Author

A92-17875

THE INFLUENCE OF VISUAL CUE UPON THE CENTER OF FOOT PRESSURE (CFP) AND MUSCLE ACTIVITIES IN POSTURE CONTROL - RED LAMP GAZE IN DARK ROOM

NORIKO NITAMI, MIKIO ONO, and HIROSHI OSADA Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 31, Dec. 1990, p. 85-97. In Japanese. refs

The influence of limited visual information on posture control is investigated by studying the bodily movements and sways in subjects focused on a red lamp in a dark room. The subjects maintain either Romberg's or Mann's posture, and the body-fat ratio is found to be correlated with body sways in the former and in the latter with the displacement density of the center of foot pressure. Red-lamp gaze tends to reduce the individual variation of the body sways, and posture control during limited visual information is related to the loss of the peripheral visual field.

C.C.S.

A92-21479

EFFECTS OF REDUCED BLOOD DISTRIBUTION IN LOWER LIMBS ON WORK CAPACITY AND RESPONSES OF BLOOD LEUKOCYTE LEVELS DURING BICYCLE EXERCISE

NAOTAKE INOUE, IZUMI TABATA, and YOSHINOBU OHIRA (National Institute of Fitness and Sports, Kanoya, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 28, June 1991, p. 27-37. In Japanese. refs

The effects of decreased distribution of blood in lower limbs in humans on the physical work capacity, cardiopulmonary function, metabolism, and responses of blood leukocytes during bicycle exercise were investigated in subjects who underwent exposures to 6-deg head-down (HD) position, resulting in a decrease of the blood volume of lower extremities. A comparison of results obtained on subjects after HD position with those exposed to head-up (HU) tilt indicated that the decrease in exercise capacity observed in the HD subjects might be due to an inhibited energy metabolism in working muscles and before the cardiopulmonary function was fully stimulated. A decrease in blood distribution in working muscles is followed by a decrease in the maximal capacity for physical exercise and an increase of the physiological stress during exercise at a given submaximal work intensity, compared to those functions in normal subjects.

I.S.

A92-29548

A STUDY ON PILOT WORKLOAD - A BASIC APPROACH TO QUANTIFY PILOT'S WORKLOAD FROM POWERS DATA

ZOJIRO KATOH, ATUSHI KADOO, SHUJI NISHII, YOSHINORI TAKEUCHI, YUKO NAGASAWA, and KENJI MATUHISA Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, June 1991, p. 1-14. In Japanese. refs

A basic approach to quantifying a pilot's workload is presented using POWERS (Pilot's Operational Workload Evaluation Research Simulator). POWERS data are composed of pilots' manipulation of controls and switches, as well as electrophysiological and flight parameter data. Data on the timing, duration, frequency, and amount of continuous and discrete manipulation of control and switches by the pilot lead to an analysis of the manipulation characteristics and complexity. Data from ECG, EOG, EEG, EMG, and respiration lead to predictions of workload index. Flight performance parameters are used to extract variables which contribute to subjective difficulty ratings.

C.D.

A92-29550

AUTOMATIC BLOOD SAMPLING SYSTEM

YOSHINORI MIYAMOTO, HIDEAKI SHIMAZU, ATSUSHI KAWARADA, HIDEO TARUI, and HIROSHI ITO (Kyorin University School of Medicine, Mitaka, Japan) Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, June 1991, p. 23-27. In Japanese. refs

An automatic blood sampling system for use in collecting blood consecutively during Gz stress in a subject has been developed. The system consists of a catheter unit, microtube pump, main control, and manifold unit which contains eight collecting tubes. Blood is automatically pumped out and fed into the manifold. The volume of blood collected by the device is controlled by the length of time the main control switch is used. The system would be useful in sampling blood during Gz stress and/or other aviation stress.

C.D.

A92-35630

EVALUATION OF TEMPERATURE ADAPTATION IN THE SPACE ENVIRONMENT

T. KAKI and AKIRA MASUMOTO (Kawasaki Heavy Industries, Ltd., Akashi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 61, 62. In Japanese. refs

Evaluation methods for temperature adaptation are presented. The concept of the thermal balance of the human body is discussed.

Y.P.Q.

A92-39166

AGE-DEPENDENCY OF SYMPATHETIC NERVE RESPONSE TO GRAVITY IN HUMANS

TADAAKI MANO, SATOSHI IWASE, TAKEMASA WATANABE, and MITSURU SAITO (Nagoya University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-121 to S-124. refs

The response of the muscle sympathetic outflow to gravitational stress and the effect of age on this response were investigated during head-up graded tilting of human subjects equipped with a tungsten microelectrode inserted percutaneously into the muscle nerve fascicle of the tibial nerve, to record the response of sympathetic nerve activity. Results of microneurography show that muscle sympathetic outflow in humans is governed by afferent inputs from baroreceptors and play an extremely important role in control of systemic blood pressure. With increase of age, the basal level of muscle sympathetic outflow becomes higher, while the muscle sympathetic nerve responsiveness to +Gz stress becomes reduced.

I.S.

A92-39182

CARDIOVASCULAR RESPONSES TO OXYGEN UPTAKE DURING EXERCISE IN AXILLARIS WATER IMMERSION

J. NAGANO (Bunka Woman's University, Tokyo, Japan), S. TORIKOSHI, K. YOKOZAWA (Tokyo Woman's Christian University, Japan), and Y. SUZUKI (Tokyo, University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-160, S-161.

The nature of the cardiovascular adjustment to dynamic exercise under conditions of microgravity was investigated by comparing cardiovascular responses to the oxygen uptake and work intensity in control subjects to responses of subjects undergoing ergometer exercises under the condition of water immersion (WI) to the axillary level. Results showed that, when dynamic upright pedaling was performed under WI conditions, the increase in systolic arterial pressure with increasing VO₂ and percent VO₂(max) was higher than in control subjects exercising under normal conditions.

I.S.

A92-39183

COMPARISON OF CARDIOVASCULAR RESPONSES DURING POST-EXERCISE BETWEEN PEDALLING EXERCISE EXPOSED TO -50 MM HG LBNP AND KNEE BEND EXERCISE

S. TORIKOSHI, K. YOKOZAWA (Tokyo Woman's Christian University, Japan), J. NAGANO (Bunka Woman's University, Tokyo, Japan), and Y. SUZUKI (Tokyo, University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-162, S-163. refs

The capacities of two tests (a mild pedaling exercise during -50 mm Hg LBNP, followed by LBNP until it could no longer be tolerated, and a 1-min-long knee bending exercise) to evaluate cardiovascular responses of humans were evaluated in young female subjects. Measurements of the tolerance capacity and the systemic, mean arterial, and diastolic pressures showed significant

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correlation (p less than 0.01) between the arterial blood pressure ratio after 1 min knee bending exercise and the postexercise LBNP tolerance time. I.S.

A92-47500

THE ANTHROPOMETRIC SURVEY FOR JASDF MEN AND WOMEN - 1988. I - METHODS AND STATISTICS OF BODY DIMENSIONS

YUKIKO KAKIMOTO, ATSUSHI KADOO, SHUJI NISHI, ZOJIRO KATOH, KIYOSHI MIZUMOTO, YOSHINORI TAKEUCHI, and YUKO NAGASAWA Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, no. 3, Sept. 1991, p. 53-104. In Japanese. refs

A92-50155

UVULA-NODULUS AND GRAVITY DIRECTION - A STUDY ON VERTICAL OPTOKINETIC-OCULOMOTOR FUNCTIONS

MAKOTO IGARASHI (Nihon University, Tokyo, Japan), NORIAKI TAKEDA (Osaka University, Japan), and SAYONG CHAE (Catholic University, Seoul, Republic of Korea) (Living and working in space; IAA Man in Space Symposium, 9th, Cologne, Federal Republic of Germany, June 17-21, 1991, Selection of Papers. A92-50151 21-54) Acta Astronautica (ISSN 0094-5765), vol. 27, July 1992, p. 25-30. refs

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Vertical optokinetic nystagmus and after nystagmus were studied in squirrel monkeys both in the upright and side-lateral positions, before and after uvulonodectomy. When the optokinetic stimulus was given, the slow-phase eye velocity of optokinetic nystagmus was significantly higher in the side-lateral position than that obtained in the upright position. This difference disappeared after uvulonodectomy. When the initial slow-phase eye velocity of optokinetic after-nystagmus was compared, the one obtained in the side-lateral position was significantly higher than that acquired in the upright position. This difference also disappeared after the uvulonodular ablation. The role of uvula and nodulus in relaying the information of gravity direction was confirmed. Author

A92-50172

ORTHOSTATIC INTOLERANCE IN 6 DEGREES HEAD-DOWN TILT AND LOWER BODY NEGATIVE PRESSURE LOADING

KAZUYOSHI YAJIMA, AKIRA MIYAMOTO, MASAO ITO, TAKAICHI MANO (Nihon University, Tokyo, Japan), and KIYOSHI NAKAYAMA (Sophia University, Tokyo, Japan) (Living and working in space; IAA Man in Space Symposium, 9th, Cologne, Federal Republic of Germany, June 17-21, 1991, Selection of Papers. A92-50151 21-54) Acta Astronautica (ISSN 0094-5765), vol. 27, July 1992, p. 115-121. Research supported by MOESC. refs

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An experimental program is undertaken to study orthostatic intolerance by means of the 6-deg HDT preceded and followed by 70-deg head-up tilt (HUT) and by means of lower-body negative pressure (LBNP). LBNP is employed to evaluate the validity of heart-rate controllability index (HRCI) which is the ratio of the relative increase of heart rate to the initial increase of leg-blood volume. Bed rest is followed by HUT and subsequently by LBNP and HUT, and the same procedure is repeated for higher values of LBNP. No orthostatic intolerance is noted at -20 mmHg LBNP, and some subjects show presyncope during the -40 mmHg LBNP. HRCI percent change is found to be minimal for the cases of the brain anemia type of orthostatic intolerance, whereas the vagotonia type of orthostatic intolerance corresponds to greater changes in HRCI percentages. C.C.S.

A92-53002

HUMAN ADAPTATION AND ITS LIMITATIONS IN A HOT ENVIRONMENT

JUNICHI SUGENOYA (Aichi Medical University, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 29, no. 1, March 1992, p. 19-21. In Japanese. refs

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The human adaptation to a hot environment, and changes in central circulation and body fluids are examined. Short-term and long-term effects are examined and compared. Y.P.Q.

A92-53739

RELATIONS BETWEEN CARDIAC FUNCTION AND BODY TILTING ANGLE

MASAMICHI SUDOH, SACHIO IKAWA, KENJI KAWAKAMI, MASATOSHI SHIOTA, KUNINOBU YOKOTA, and YOSHIO HONDA (Jikei University, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2047-2052. refs

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The head-up and head-down position of 28 healthy males were changed while changes were conducted in stroke volume, heart rate, transthoracic impedance, and systolic and diastolic blood pressure (DBP). Mean arterial pressure (MAP), pulse pressure, and total peripheral resistance were also calculated. While there were almost no changes in blood pressure in the head-down tilt, head-up tilting led to changes in DBP, heart rate, and MAP. Stroke volume and cardiac output increased with downtilt and decreased with uptilt. O.C.

A92-53740

CHANGE OF SKIN BLOOD FLOW BY BODY TILTING

KENJI KAWAKAMI, MASAMICHI SUDOH, TAKAO SHIMADA, YUTAKA MORI, MASATOSHI SHIOTA, and SACHIO IKAWA (Jikei University, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2053-2058. refs

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Radionuclide methods were used to study the effect of body tilt on the hemodynamics of the human body's lower limbs. While decreased skin blood flow in the head-up position was associated with a decrease of total limb flow, skin blood flow in the head-down position decreased despite the enhancement of total limb flow. The peripheral-perfusion resistance was also increased in the head-up position; regulation in the cutaneous hemodynamics may be different from that in the systemic circulation. O.C.

A92-53741

EFFECTS OF PASSIVE ANGULAR BODY MOVEMENT ON SOLEUS H-REFLEX IN HUMANS

CENYO MITARAI (Chukyo University, Toyota, Japan) and MITSUHIRO KOEDA IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2059-2063. refs

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The purpose of this experiment was to investigate influence of semicircular canal inputs on the activity of the lumbo-sacral motoneuron pool in humans. The rotating chair was used for preferred stimulation of the lateral semicircular canal, and the amplitude modification of the soleus H-reflex by rotation was observed. The results obtained from eighteen healthy young male subjects showed that the H-reflex was suppressed, without any exception, by exposing to both acceleration and deceleration. The suppression was a function of the exposure time as well as of the intensity of acceleration. From these results, it was suggested that sensory inputs from the semicircular canal exert inhibitory effect on the spinal motoneuron of lower limb; these effects are mediated through the vestibulo-reticulo-spinal tracts. Author

A92-53742

CHARACTERISTIC CHANGE OF MUSCULAR SYNERGY DURING ISOMETRIC CONTRACTION UNDER WEIGHTLESSNESS SIMULATED BY WATER IMMERSION

YASUHIRO SUGAJIMA (Chukyo University, Toyota, Japan) and GENYO MITARAI IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990,

Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2065-2069. refs
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The present study examines whether muscle relaxation under weightlessness results in changes of synergetic activities in the joint muscle groups of lower limbs during voluntary contraction. The subjects were healthy male volunteers. During water immersion (WI), electromyogram discharges became less and it was specially noticed that the rate of increase following increase of contraction force changed in each muscle compared with those without WI. It was found that large transient spikes appeared under WI. The results suggested that the synergy of muscle groups was changed by weightlessness. Author

A92-56464

MOTION SICKNESS AND EQUILIBRIUM ATAXIA

MASAHITO TAKAHASHI, YASUHIKO TAKEI, AKIRA SAITO, YUKIHIRO OKADA, and JIN KANZAKI (Keio University, Tokyo, Japan) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 6, June 1992, p. 486-490. refs
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In order to know the relationship between motion sickness and equilibrium ataxia, Graybiel's ataxia test battery was performed on ten normal subjects: (1) before donning goggles which reversed the optical image horizontally and vertically, (2) while wearing the goggles and walking, and (3) after walking as long as possible up to 90 min. Horizontal reversal of vision resulted in a statistically significant decrease in the score for all the closed-eyes tests and one open-eyes test performed during walking and after walking, respectively. In contrast, walking while wearing vertical reversing goggles produced a significant but very small change for one of the closed-eyes tests alone. The present study indicates that failure to detect spatial orientation, which evokes autonomic nervous symptoms as an alarm sign, produces equilibrium ataxia by impairing the top-down regulation of body balance, and that vertically reversed vision does not impair spatial orientation need to maintain upright posture or to execute locomotion. Author

N92-16549# Japan Atomic Energy Research Inst., Tokyo.

DEEP CODE TO CALCULATE DOSE EQUIVALENTS IN HUMAN PHANTOM FOR EXTERNAL PHOTON EXPOSURE BY MONTE CARLO METHOD

YASUHIRO YAMAGUCHI (Japan Atomic Energy Research Inst., Ibaraki.) Jan. 1991 75 p
(DE91-780319; JAERI-M-90-235) Avail: CASI HC A04/MF A01

The present report describes a computer code, DEEP, which calculates the organ dose equivalents and the effective dose equivalent for external photon exposure by the Monte Carlo method. MORSE-CG, a Monte Carlo radiation transport code, is incorporated into the DEEP code to simulate photon transport phenomena in and around a human body. The code treats an anthropomorphic phantom represented by mathematical formulae and user has a choice for the phantom sex: male, female, and unisex. The phantom can wear personal dosimeters on it and user can specify their location and dimension. This document includes instruction and sample problem for the code as well as the general description of dose calculation, human phantom, and computer code. DOE

N92-17802# Kyoto Univ., Kumatori (Japan). Research Reactor Inst.

PROCEEDINGS OF THE CONFERENCE ON HEALTH PHYSICS
TADASHI TSUJIMOTO, ed. and MITSUO MIZUMA, ed. Mar. 1991 35 p In JAPANESE; ENGLISH summary Conference held in Kumatori, Japan, 20 Mar. 1990
(DE92-704335; KURRI-TR-347; CONF-9003295) Avail: CASI HC A03/MF A01

This booklet presents nine talks given at the Conference on Health Physics, which was held on March 20, 1990, at Research Reactor Institute of Kyoto University (KURRI), Japan. The first talk discusses future trends in health physics, focusing on the application of computers, development of new techniques, energy industries, and administrative regulations. The second talk

discusses the importance of health physics in relation to nuclear energy. The third one addresses importance of health physics in relation to medical treatment. The fourth and fifth ones discuss the present status and future trends in education in health physics. The sixth one focuses on education in health physics, placing emphasis on grass-roots activities in this field. The seventh and eighth talks discuss various activities to be carried out in the future by the Health Physics Research Center. The ninth one describes major developments leading to the establishment of the Health Physics Research Center. Three appendices are attached which respectively summarizes major subjects at a meeting on the budget for the Health Physics Research Center, outlines some studies for radiation control in space aircraft and space bases, and describes major reasons for the necessity of the Health Physics Research Center. DOE

N92-27349# California Univ., Berkeley. Lawrence Berkeley Lab.

THE CARCINOGENIC RISKS OF LOW-LET AND HIGH-LET IONIZING RADIATIONS

J. I. FABRIKANT Aug. 1991 37 p Presented at the 32nd Annual Meeting of the Japan Radiation Research Society, Kitakyushu-shi, Japan, 29 Aug. 1989 Revised
(Contract DE-AC03-76SF-00098)
(DE92-010477; LBL-27728-REV; CONF-8908169-1) Avail: CASI HC A03/MF A01

This report presents a discussion on risk from ionizing radiations to human populations. Important new information on human beings has come mainly from further follow-up of existing epidemiological studies, notably the Japanese atomic bomb survivors and the ankylosing spondylitis patients; from new epidemiological surveys, such as the patients treated for cancer of the uterine cervix; and from combined surveys, including workers exposed in underground mines. Since the numerous and complex differences among the different study populations introduce factors that influence the derived risk estimates in ways that are not completely understood, it is not clear how to combine the different risk estimates obtained. These factors involve complex biological and physical variables distributed over time. Because such carcinogenic effects occur too infrequently to be demonstrated at low doses, the risks of low-dose radiation can be estimated only by interpolation from observations at high doses on the basis of theoretical concepts, mathematical models, and available empirical evidence, primarily the epidemiological surveys of large populations exposed to ionizing radiation. In spite of a considerable amount of research, only recently has there been an effort to apply the extensive laboratory data in animals to define the dose-incidence relationship in the low dose region. There simply are insufficient data in the epidemiological studies of large human populations to estimate risk coefficients directly from exposure to low doses. The risk estimates for the carcinogenic effects of radiation were, in the past, somewhat low, and reassessment of the numerical values is now necessary. DOE

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A92-29549

DEVELOPMENT OF NEW PILOT SELECTION TEST - PRELIMINARY STUDY ON THE SYSTEM OF THE SHORT-TERM MEMORY AND THE ATTENTION DIVISION TEST

KYOICHI NAGATSUKA and YOSHINORI TAKEUCHI Japan Air Self Defence Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 32, June 1991, p. 15-22. In Japanese. refs

Two types of personal computer-based tests, developed to

53 BEHAVIORAL SCIENCES

assess abilities regarding short-term memory and division of attention, have been evaluated using aviation candidates. The results suggest that the tests are promising as predictors of pilot selection. C.D.

A92-43114

STUDY ON ZERO FLIGHT TIME TRAINING

K. IWASE (Japan Airlines, Technical Institute, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 104-107. In Japanese.

A pilot training program using a computer-aided simulator is presented. The requirement for establishing the zero flight training system is discussed. Comparisons between Japanese and other countries' pilot training data are presented. Y.P.Q.

A92-43165

A SIMULATOR FOR PILOT AND CREW TRAINING

M. WATANABE IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 322-325. In Japanese. refs

A simulator for antitank helicopters is described. The simulated emergency status design and training methods are described and future applications of the simulator are considered. Y.P.Q.

A92-53001

PSYCHOLOGICAL PROBLEMS ON A SPACE STATION

MINORU KUME (Waseda University; NASDA, Tokyo, Japan), SEI YUMIKURA, MAKOTO DOI, and CHIHARU SEKIGUCHI (NASDA, Tokyo, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 29, no. 1, March 1992, p. 1-15. In Japanese. refs

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Research on psychological problems, associated with isolation and confinement, that may occur on a space station is discussed. Space flight simulation testing is described, and mental health factors in space flight are discussed. Psychological support for crew members on a space station is described. Y.P.Q.

A92-56060

AN EXPERIMENT ON PILOT'S VISUAL CUES IN LOW ALTITUDE HELICOPTER FLIGHT

HIROYASU KAWAHARA, AKIRA WATANABE, KEIJI TANAKA, KAORU WAKAIRO, and KOHEI FUNABIKI (National Aerospace Laboratory, Chofu, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 266-269. In Japanese. refs

In order to obtain technical data to be utilized for preventing helicopter accidents caused by human pilots, a flight experiment was conducted by National Aerospace Laboratory, as a part of the urgent research on safety of helicopter operations by the Science and Technology Agency. This paper describes the flight research on pilot's visual cues, which has three themes: visual cues during dropping dusting-powder, identification of cables, and visual cues during hovering and forward flights. Human visual scanning behavior was monitored by an eye-mark-recorder. The results revealed human regular scanning behavior and low ability to identify cables. Author

N92-25372# National Space Development Agency, Tokyo (Japan). Space Station Program Dept.

PAYLOAD CREW TRAINING IN FUWATTO 1992 (FIRST MATERIAL PROCESSING TEST) PROJECT

MAMORU MOURI and SHIGEKI KAMIGAICHI In its Preprints of NASDA's 6th Technical Symposium p 1-22 5 Jun. 1991 In JAPANESE; ENGLISH summary

Avail: CASI HC A03/MF A02

The plan and the status of FUWATTO'92 payload crew training for Japanese payload specialist and NASA mission specialist is reported. NASDA (National Space Development Agency of Japan) is preparing for the FUWATTO'92, FMPT (First Material Processing Test) planned in September, 1992 in which the space experiments

will be conducted on the Space Shuttle and Spacelab. Dr. Mamoru Mouri, Japanese payload specialist, will operate the space experiments on board. Author (NASDA)

N92-33856# National Space Development Agency, Tokyo (Japan). Space Station Program Dept.

JEM DEVELOPMENT STATUS AND PLAN FOR JEM CREW TRAINING

KAZUHIKO YONEYAMA In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 31-47 21 Jan. 1992 In JAPANESE

Avail: CASI HC A03/MF A02

The outline, the operation plan, and the development schedule of JEM (Japanese Experiment Module) are described. The status of JEM crew training is also outlined. The following topics are addressed: conceptual drawings of the JEM; characteristics of JEM; structure of JEM pressurized module; equipment layout on exposed facilities; fundamental issues for space station operation; conceptual drawings of JEM operation system; major JEM development and operation schedule; description of Japanese space station crew; the process from space station crew selection to their getting aboard the station; selection criteria of JEM crew; Japanese astronaut education and training schedule; details of JEM crew training; and participation in Mission Specialist (MS) training. Author (NASDA)

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A92-12470

DEVELOPMENT OF FLYING TELEROBOT MODEL FOR GROUND EXPERIMENTS

YOSHITSUGU TODA, TOSHIKI IWATA, KAZUO MACHIDA (Electrotechnical Laboratory, Tsukuba, Japan), AKIKO OTSUKA, HIDETOSHI TORIU, and YASUO SHINOMIYA (Toshiba Corp., Komukai Works, Kawasaki, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p. refs (IAF PAPER 91-056) Copyright

A space telerobot model for ground experiments is presently operable for free flying and manipulating on a 2D flat test bed with an air bearing system. A method is proposed for cooperative control between the robot body's attitude control and the manipulator position control that indicates adequate performance. The manipulator force control methods, e.g., impedance control and the active limp, are very effective while capturing and handling a floating object in a microgravity field. R.E.P.

A92-18566

CELSS NUTRITION SYSTEM UTILIZING SNAILS

Y. MIDORIKAWA, T. FUJII (JGC Corp., Tokyo, Japan), A. OHIRA (Institute of Highland Agriculture, Tokyo, Japan), and K. NITTA (National Aerospace Laboratory, Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 7 p. refs

(IAF PAPER 91-576) Copyright

A nutrition system for a lunar base CELSS was described by Midorikawa et al. (1989). A lunar base with a total of eight crew members was envisaged. In the paper, four species of plant, namely rice, soybean, lettuce, and strawberry were introduced to the system. Based on the supply of nutrition from these plants, the fundamental nutritional needs of the crew members could be satisfied. The supply of nutrition from plants and the human nutritional requirements could almost be balanced. The study revealed that the necessary plant cultivation area per crew member occupied nearly 40 square meters in the lunar base. The sources

of nutrition considered in the study were energy, sugar, fat, amino acids, inorganic salt, and vitamins; however, calcium, vitamin B2, vitamin A, and sodium were found to be lacking. Therefore, a subsystem to supply these elements is of considerable value. This paper reports on a study for breeding snails and the utilization of the snail meat as food. Nutrients supplied from snails are shown to compensate for the above mentioned lacking elements. The snail breeder and the associated food supply system are evaluated as a subsystem of the CELSS functioning to provide valuable nutrients.

Author

A92-20971

INTERFACE PROBLEMS BETWEEN MATERIAL RECYCLING SYSTEMS AND PLANTS

KEIJI NITTA, MITSUO OGUCHI, and KOJI OTSUBO (National Aerospace Laboratory, Chofu, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 11-19. refs

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The requirements are identified of material-recycling subsystems for the plant-cultivation modules (PCMs) of CELSS systems. A review is given of metabolic data for human beings as well as plants to be utilized in a CELSS project. The paper then examines the material-recycling systems proposed for Habitat modules and PCMs by means of flow charts that identify such components as element synthesizers, recovery and reclamation vessels, and CO2 and O separators. Testing of the material-recycling techniques is described in a small closed chamber with five subsystems for lighting, growth, air conditioning, gas measurement, and gas-concentration control. Metabolic-balance data is shown to be the most important reference for evaluating control methods for PCMs and material-recycling systems and their interfaces.

C.C.S.

A92-20972

EVALUATIONS OF CATALYSTS FOR WET OXIDATION WASTE MANAGEMENT IN CELSS

MITSUO OGUCHI and KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 21-27.

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The applicability of wet oxidation to CELSS systems is assessed in terms of catalysts for activating effective oxidation levels and reducing residual levels of acetic acid and ammonia. The experimental setup is described in which a catalytic reactor is introduced for the wet oxidation of rabbit waste. Noble metals are employed as catalysts such as Ru, Rh, and Pd via Al2O3 or TiO2 pellets and a stainless-steel honeycomb that provides high oxidation resistance. The waste is decomposed for 30 minutes in both the reactor with and without catalysts, and levels are determined of the subsequent CO2, total organic C and N, and other chemical contents. The organic wastes are fully decomposed, and the resulting gas is harmless; however, the postoxidation sludge is found to contain concentrations of Al, Pd, Ru, and Rh due to degradation of the aluminum oxide catalyst vessel.

C.C.S.

A92-20973

A STUDY OF BIOHAZARD PROTECTION FOR FARMING MODULES OF LUNAR BASE CELSS

T. FUJII, Y. MIDORIKAWA, M. SHIBA (JGC Corp., Tokyo, Japan), M. TERAJ (Tokyo Institute of Science and Technology, Hino, Japan), K. OMASA (National Institute for Environmental Studies, Tsukuba, Japan), and K. NITTA (National Aerospace Laboratory, Chofu, Japan) (Life sciences and space research XXIV/4/ - Natural

and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 29-32. refs

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For the Closed Ecological Life Support System (CELSS) of a manned lunar base which is planned to be built on the moon early in the 21st century, several proposed programs exist to grow vegetables inside a farming module. At the 40th IAF (Malaga, 1989) a proposal is presented for supplying food and nutrients to a crew of eight members, a basic concept which is based on growing four kinds of vegetables. This paper describes measures for biohazard protection in farming modules. In this study, biohazard protection means prevention of the dispersion of plant diseases to other plant species or other portions of farming beds.

Author

A92-20975

TEMPERATURE AND HUMIDITY CONTROL SYSTEM IN A LUNAR BASE

N. IZUTANI, N. KOBAYASHI, T. OGURA, I. NOMURA, M. KAWAZOE, and H. YAMAMOTO (Daikin Industries, Ltd., Mechanical Engineering Laboratory, Sakai, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 41-44. refs

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The objective of the present work is to evaluate a temperature and humidity control system which will allow man to live and work on the moon while developing lunar resources. The results of thermal load calculation show that the load of electric lighting is 80 to 90 percent of the cooling load in the habitat module and that only the cooling function is required for temperature control. Due to this, a fluorocarbon refrigerant heat pump system was selected to satisfy reliability, energy consumption, size, and weight requirements for the lunar base equipment. According to the load calculation, occupants will feel discomfort due to radiant heat from lighting fixtures. To resolve this problem, an air conditioning system, used in combination with forced convective cooling and panel cooling on the ceiling, was adopted in the living space. Moreover, the experiment on the ground was carried out to evaluate the effects of panel cooling.

Author

A92-20977

CATALYTIC WET-OXIDATION OF HUMAN WASTES PRODUCED IN SPACE - THE EFFECTS OF TEMPERATURE ELEVATION

N. TAKEDA and Y. TAKAHASHI (Niigata University, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 53-56. refs

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The filtrate of noncatalytical wet-oxidized sewage sludge was wet-oxidized again at 290 C and 300 C with a Ru-Rh catalyst. At each temperature, repeated batch tests were carried out. Both oxidation and denitrification efficiency of organic matter in the raw material were studied. In the 16 times batch tests at 300 C, high and stable oxidation occurred; 98.0 percent of organic carbon in the raw material was oxidized and 98.3 percent of organic nitrogen was denitrified. At 290 C, though high and stable denitrification occurred, oxidation did not occur highly and stably. A catalytic wet-oxidation system studied at 300 C will be useful as a waste management system for a human life support system, where almost all food is resupplied from the earth. This system can prevent organic waste accumulation in the life support system.

Author

A92-20978

MATERIAL RECYCLING IN A REGENERATIVE LIFE SUPPORT SYSTEM FOR SPACE USE - ITS ISSUES AND WASTE PROCESSING

Y. TAKAHASHI and KAZUHIRO TANAKA (Niigata University, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 65-73. refs

Copyright

Sources of wastes produced in future human activities in space are discussed. The quantity and quality of each source is evaluated. Water quality requirements for human safety are shown. Then, techniques to be used for processing and/or recycling the wastes to attain the requirements are listed. Specific characteristics and limitations of each are explained. Examples of system configurations of the techniques are shown. The material balances are calculated.

Author

A92-21151

SMART END EFFECTOR FOR DEXTEROUS MANIPULATION IN SPACE

KAZUO MACHIDA, YOSHITSUGU TODA, TOSHIKI IWATA (MITI, Electrotechnical Laboratory, Tsukuba, Japan), and TADASHI KOMATSU (Toshiba Corp., Kawasaki, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, Jan.-Feb. 1992, p. 10-16. Previously cited in issue 21, p. 3423, Accession no. A90-47687. refs

Copyright

A92-21832

SMALL LIFE SUPPORT SYSTEM FOR FREE FLYER

TOSHIYOSHI KIMURA, HARUHI SHIMIZU, YOSHIHITO NISHIO, MASAHIRO TAKAYANAGI, NAOTO KAWASE (Fujitsu, Ltd., Tokyo, Japan), MASAMICHI YAMASHITA, and AKEMI IZUMI-KUROTANI (Institute of Space and Astronautical Science, Sagami-hara, Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs (SAE PAPER 911428) Copyright

A self-contained closed-loop life support system has been developed for biological experiments conducted on the Japanese Space Flyer Unit (SFU). The modular and flexible system design is described, and the experiment's objectives regarding the effects of microgravity and space environment on the development of fertilized eggs are reviewed. The life support system and the control and information system are described.

C.D.

A92-21833

STUDY OF OXYGEN GENERATION SYSTEM FOR SPACE APPLICATION

H. ISHIDA, T. SHOJI (Kawasaki Heavy Industries, Ltd., Kobe, Japan), and Y. KITAZAWA (Chlorine Engineers Corp., Ltd., Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs (SAE PAPER 911429) Copyright

The development status of an oxygen generation system for space applications which uses a new solid polymer electrolyte and simplified cell structure is described. A tradeoff study of water feed methods and the combination of electrodes with electrolyte membranes is reviewed, and the selection of a cathode liquid feed and the use of the zero-gap technique to make electrode membranes is explained.

C.D.

A92-21834

CONCEPTUAL DESIGN OF SNAIL BREEDER ABOARD SPACE VEHICLE

T. FUJII, Y. MIDORIKAWA (JGC Corp., Tokyo, Japan), A. OHIRA (Institute of Highland Agriculture, Japan), and KEIJI NITTA (National Aerospace Laboratory, Tokyo, Japan) SAE, International

Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs

(SAE PAPER 911430) Copyright

A snail-breeding module is described which will serve as a subsystem of the Closed Ecological Life Support System (CELSS), providing the space crew with animal nutrients. Automated operations for feeding the animals, treating their wastes, and taking care of their offspring are described. A submodule which processes the snails for food production is also presented.

C.D.

A92-21835

LIFE SUPPORT CONCEPT IN LUNAR BASE

KEIJI NITTA (National Aerospace Laboratory, Tokyo, Japan) and HISAO HABUKA (Institute for Future Technology, Tokyo, Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs (SAE PAPER 911431) Copyright

In order to support NASA's Space Exploration Initiative, an independent conceptual study of a man-tended lunar outpost has been conducted by a NASDA group. This paper discusses the required area for habitation, the structure of a permanent lunar base, and the life support system to be installed in each module. The designs of the modules are shown, including plantation module, habitat modules, and a closed ecological experimental facility. A material recycling system for the plantation module is shown and module subsystems are listed.

C.D.

A92-23657

DESIGN AND DEVELOPMENT STATUS OF THE JEMRMS

K. KURAOKA (NASDA, Tokyo, Japan), K. GOMA, T. SUMI, and R. OKAMURA (Toshiba Corp., Space Programs Div., Kawasaki, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 23-26. refs

The JEM Remote Manipulator System (RMS) under development for the Space Station Freedom is described in terms of the status and salient characteristics of the design. Two manipulators are delineated which include a 10-m primary arm and a 2-m small fine arm intended for, respectively, transfer operations and dexterous tasks. The automatic control mode of the larger main arm is discussed although, manual input is also possible with a six-DOF hand controller. The small arm is manually operated, and the system is described in terms of the bilateral and master-slave modes that are available. Feedback force for both arms can be detected by a force-moment sensor, and several tests are described to examine the specific components. A 2D functional model is illustrated that has verified some of the primary precepts of the JEMRMS project designs.

C.C.S.

A92-23666

DEVELOPMENT OF DUAL ARM TELEOPERATED SYSTEM FOR SEMIAUTONOMOUS ORBITAL OPERATIONS

HIROSHI KOYAMA, HIROYUKI TAMURA, KYOUSUKE KAWABATA, and NORIMASA YOSHIDA (Mitsubishi Electric Corp., Kamakura Works, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 65-68. refs

This paper deals with several concepts to facilitate the development of a practical teleoperated system for semiautonomous dual-arm space robots. The concept of local arm-control functions and problems related to the handling object's design and object-handling sequences are presented and discussed. A dual-arm teleoperated system is described to confirm the present approach to the problem. Truss-structure assembly experiments are performed for this purpose.

Author

A92-23668

RESEARCH AND EXPERIMENT OF ACTIVE COMPLIANCE END EFFECTOR (ACE)

YOSHITSUGU TODA, TOSHIKI IWATA, KAZUO MACHIDA (Electrotechnical Laboratory, Tsukuba, Japan), TADASHI

KOMATSU, CHIAKI HONDA, and KAZUHIRO KASUGA (Toshiba Corp., Kawasaki, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 73-76.

The development of a smart end effector is expected to perform precise on-orbit activity by space robots instead of EVA by astronauts. The Active Compliance End effector (ACE) is developed as a step of the research of the future space robotics technologies. The ACE mainly consists of an effector mechanism, controller, gripper, proximity sensor and force/torque sensor. The experimental demonstrations of on-orbit high functional tasks using ACE, such as 'pin insertion', 'flying-target capture' and others are performed on the 2D air-bearing table at ETL. The experimental tests regarding position/velocity feedback control, velocity feedforward compensation, and force/torque feedback control are performed and confirm the feasibility and applicability of space robot system in the future. Author

A92-23669

AUTONOMOUS CAPTURE EXPERIMENT OF FREE-FLYING TARGET ON THE ZERO GRAVITY SIMULATOR

HARUHIKO SHIMOJI, MASAO INOUE, KAZUO TSUCHIYA (Mitsubishi Electric Corp., Amagasaki, Japan), KEIKEN NINOMIYA, ICHIRO NAKATANI, and JUN'ICHIRO KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 77-80. refs

This paper presents a developed experimental robot system that can recognize target position and control a manipulator accordingly. The algorithm for recognizing the position and the orientation of the target from visual information using extended Kalman filter is proposed. The algorithm to control the manipulator according to these information is proposed. Finally, automatic capture experiments of the free-flying target on the 6-DOF zero-gravity simulator where the relative motion between the robot and the target exists are presented. The validity of the proposed algorithms is confirmed in the experiments. Author

A92-23718

FORCE-REFLECTING BILATERAL MASTER-SLAVE TELEOPERATION SYSTEM IN VIRTUAL ENVIRONMENT

TETSUO KOTOKU, KAZUO TANIE, and AKIO FUJIKAWA (Mechanical Engineering Laboratory, Tsukuba, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 295-298. refs

The construction of a bilateral manipulation system in a virtual environment is examined in terms of critical technological issues required for this development. A method is developed for representing the constraint forces applied to the robot via the virtual environment based on a force-generation algorithm. A direct-drive master arm is presented which can produce constraint forces from a virtual environment using the proposed technique. An experimental scenario is developed based on the technique and master arm in which an operator attempts to locate an object in a virtual environment which includes a force-reflecting master manipulator system. Preliminary results indicate that a force-reflecting master-slave system is useful because the force information is helpful for environment recognition. The development of a bilateral teleoperation system is of interest to the teleoperation of robotics in aerospace applications while avoiding the detrimental effects of the communication time delay. C.C.S.

A92-35612

ON THE PAYLOAD INTEGRATION OF THE JAPANESE EXPERIMENT MODULE (JEM)

HIROSHI INOUE, YOSHIYUKI HASEGAWA (NASDA, Tokyo, Japan), KIYOTSUGU IZUMIZAWA, and HIROAKI YOSHINO (Manned Space Systems, Inc., Japan) IN: Space Station

Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 19, 20. In Japanese.

The payload integration of the Japanese Experiment Module (JEM) is analyzed. The flow chart of the physical integration is presented. Y.P.Q.

A92-35628

MOTION CONTROL TESTS OF SPACE ROBOTS USING A TWO-DIMENSIONAL MODEL

TADASHI KOMATSU, MICHIOHITO UENOHARA, SHOICHI IKUMI (Tokyo Metropolitan Institute of Technology, Japan), HIROFUMI MIURA, and ISAO SHIMOYAMA (Fujitsu, Ltd., Kawasaki, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 57, 58. In Japanese.

A new approach for the control moment gyro (CMG) and attitude control of the Space Station is suggested. The configurations of a two-dimensional model for the experiment are given. Computational simulations of the model are analyzed. Y.P.Q.

A92-35629

EVALUATION AND TEST ON HAND CONTROLLERS OF THE JAPANESE EXPERIMENTAL MODULE REMOTE MANIPULATOR SYSTEM (JEMEMS)

TATSUO MATSUEDA, K. KURAOKA (NASDA, Tokyo, Japan), SHOICHI TSUDA, SHIICHIRO NINSHIDA, and M. TANAKA (Toshiba Corp., Kawasaki, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 59, 60. In Japanese. refs

The test objective and methods for the Japanese Experimental Module Remote Manipulator system (JEMEMS) are presented. Evaluation objects of the hand controllers are discussed. The test data are examined. Y.P.Q.

A92-35631

STUDY ON AIR FLOW ADJUSTMENT FOR TEMPERATURE AND HUMIDITY CONTROL

H. SUGIMOTO and AKIRA MASUMOTO (Kawasaki Heavy Industries, Ltd., Akashi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 63, 64. In Japanese.

Air flow distribution performance for temperature and humidity control is presented. The air flow distribution variations are discussed. Y.P.Q.

A92-35632

THE WATER REGENERATING EQUIPMENT FOR A SPACE STATION

ONO SHIGERU, S. INAGAKI, and TOSHIMIZU KANEMURA (NEC Corp., Kawasaki, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 65, 66. In Japanese.

The water regenerating systems for a manned space station are reviewed. The fluid management technologies under microgravity, such as pressure control, flow velocity, and temperature control, are presented. The processing method of the gas components associated with water regeneration is discussed. Y.P.Q.

A92-42796

COCKPIT ERGONOMICS

YUKO NAGASAWA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 460, 1992, p. 259-268. In Japanese. refs

The concept of human factors engineering for pilot training and work is discussed. Pilot work load is defined and its evaluation method is analyzed. The relationship between aircraft cockpit design and human factors engineering is presented. The head up

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display (HUD) system, sound control, operational automation, and the pilot support system are emphasized. Y.P.Q.

A92-43111

STUDY ON A RESEARCH AND DEVELOPMENT SIMULATOR FOR PILOT CUES

MASANARI AIBARA, T. SHINAGAWA, and MANABU HIROSE (Fuji Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 92-95. In Japanese. refs

A stable control evaluation for an aircraft simulator is discussed. The multifunction display of the simulator is described. Y.P.Q.

A92-43116

STUDY ON A WORKLOAD RESEARCH SIMULATOR

ZOJIRO KATOH, SHUJI NISHI, and YUKO NAGASAWA IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 112-115. In Japanese. refs

The pilot's operational workload evaluation research simulator (POWERS) is presented. The measurement of the workload includes: subjective opinion rating, spare mental capacity, primary task assessment, and physiological measurements. The performance, characteristics and data collection ranges of POWERS are described. Y.P.Q.

A92-43188

IN-FLIGHT SIMULATOR FOR MANUAL CONTROL TESTS OF INSTABILITY

MASAKI KUMODA, M. KUROSU (Tokyo Metropolitan Institute of Technology, Japan), YUKICHI TSUKANO (National Aerospace Laboratory, Tokyo, Japan), and NAGAKATU KAWAHATA (Nihon University, Chiba, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 416-419. In Japanese. refs

The response feedback and explicit model following methods for control simulation are presented. The flight test of manual control of instability is discussed. The RSS aircraft fault model of the manual control system is analyzed. Y.P.Q.

A92-43214

DISPLAY EQUIPMENT AND MAN-MACHINE INTERFACE

T. NISHIMURA (NEC Corp., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 520-523. In Japanese.

A man-machine interface is presented. The differences between man and machine are analyzed, such as sensing, information transmission speed, error, and soft response. The characteristics of various display systems are compared. The HUD system is addressed. Y.P.Q.

A92-43215

STUDY OF A MONITORING SYSTEM

T. SUYAMA (Mitsubishi Electric Corp., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 524-527. In Japanese. refs

Man-machine interface design for an industrial plant and a large display for aiding managerial judgment are discussed. Cognitive, perceptual, and anthropometric application technologies are addressed. Y.P.Q.

A92-43216

STUDY OF A SPACE ROBOT FOR OPERATION IN ORBIT

MITSUSHIGE ODA (NASDA, Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 528-531. In Japanese. refs

Different types of orbital operation of a space robot are presented. Space robot structures and technology are discussed,

and the issues of time delay and data communication capacity are addressed. Y.P.Q.

A92-43223

THE CHARACTERISTICS OF A LIQUID CRYSTAL FLAT PANEL DISPLAY

C. UDAGAWA IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 556-559. In Japanese. refs

The characteristics of a liquid crystal display (LCD) are presented. A comparison between LCD and CRT is given and future tasks for LCD of the next generation are discussed. Y.P.Q.

A92-50181

MATERIAL FLOW ESTIMATION IN CELSS

KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan) (Living and working in space; IAA Man in Space Symposium, 9th, Cologne, Federal Republic of Germany, June 17-21, 1991, Selection of Papers. A92-50151 21-54) Acta Astronautica (ISSN 0094-5765), vol. 27, July 1992, p. 205-210. refs

Copyright
The requirements of CELSS subsystems for a lunar base are evaluated with estimates of material flows required to support expected levels of human and plant life. The life-support functions to be installed in the habitat include initial-phase requirements for CO₂ elimination and O₂ recovery as well as operational-phase functions including water reclamation and nitrogen decomposition. Detailed flow estimates are given for water circulation, gas circulation, and plant physiological parameters, and flow charts detail the recycling systems assumed for the habitat, plant-cultivation, and plantation modules. Among the specific results are the assumptions of CO₂, N₂, and O₂ flows within and between the individual modules in grams/person per day. The results should be changed according to changing physical parameters of the lunar base, but the results are of use in the design of the modules and subsystem-flow parameters. C.C.S.

A92-53620

COLLISION AVOIDANCE FOR MANIPULATORS USING VIRTUAL HINGES

OSAMU OKAMOTO, YOSHIKI OHKAMI, TAKASHI KIDA, and ISAO YAMAGUCHI (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1211-1216. refs

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A new method for collision avoidance is proposed for manipulator trajectory control. The method is based on the unified matrix approach used in the formulation of multibody system dynamics, and also on the introduction of 'virtual' hinges that restrict to a manipulator tip motion to a desired motion and prevent the arms from collision with obstacle(s). This algorithm can be applied not only to digital simulation of a system in order to evaluate the path generator and controller performance but also to generation of the real time control law. Some numerical results are shown for illustration as applied to the 4 arm manipulator and one obstacle. Author

A92-53621

MISSION-FUNCTION CONTROL OF A SPACE MANIPULATOR FOR CAPTURE OF A MOVING OBJECT

HIRONORI FUJII, TSUTOMU MURAYAMA, and KAZUNARI NAKAJIMA (Tokyo Metropolitan Institute of Technology, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1217-1222. refs

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The control problem presently treated involves the capture of an object, which may be a drift in space, by a space manipulator that is mounted on a space structure; for the sake of simplicity. Only planar motion is treated. The mission-function control algorithm, which has its basis in the Liapunov method for nonlinear

dynamical systems, is employed. Numerical simulation results indicate excellent control-algorithm performance in this microgravity object-capture task. O.C.

A92-53622

DEVELOPMENT OF A 6 DOF HAND CONTROLLER

SHINICHI TAKARADA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), TARO IWAMOTO (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Tsuchiura, Japan), KENJIROU KUMAMOTO, and NAOYA EZAWA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1223-1228. refs

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NASA's Space Station Freedom will employ a six-degree-of-freedom 'hand controller' (H/C) for operations requiring exceptional dexterity in virtue of working envelope, safety, or system-resources criticality. The H/C employs a terminal motion-corresponding control scheme, in conjunction with resolved-motion control. High design commonality in the H/C's joints yields enhanced cost effectiveness for the design. O.C.

A92-53623

ROBOTS FOR SPACE EXPERIMENTS

KOHTARO MATSUMOTO and SEISIROH KIBE (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1229-1234. refs

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An account is given of the configuration and projected performance of a robotic space-experiments facility that is based on near-term technologies and may enter operation after 2003, in conjunction with the JEM module associated with NASA's Space Station Freedom. The most significant considerations in the design of these robotic systems are (1) the lack of task-repeatability for which industrial robots are produced, and (2) the critical importance of AI in the requisite autonomous analyses of experiment results. O.C.

A92-53624

A CONCEPT ON DOCKING MECHANISM FOR IN-ORBIT SERVICING

HIDEHIKO MITSUMA, EIICHI ENDO (NASDA, Tsukuba Space Center, Japan), TORU GYOGI, YOKO WATABE, MASAO AKIYAMA, and HIDEKI NAKAJIMA (Nissan Motor Co., Ltd., Aerospace Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1235-1242. Research supported by NASDA. refs

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A robotic autonomous docking mechanism will be developed in Japan for NASA's Space Station Freedom which will possess the greatest degree of docking and berthing operational flexibility, on the basis of a 'modular mechanisms' concept. This concept involves the distribution of operational capabilities among such modular mechanical elements as a boom mechanism, a structural latch mechanism, an umbilical connection mechanism, and a suite of sensors and controllers. An analysis has been conducted of these modular elements. O.C.

A92-53625

RESEARCH AND DEVELOPMENT OF A TELE-ROBOT FOR SPACE USE

YOSHITUGU TODA, TOSHIKI IWATA, and KAZUO MACHIDA (Electro-Technical Laboratory, Tsukuba, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1243-1246.

Copyright

An account is given of the development status for an EVA-oriented telerobotic system; work has progressed to the

fabrication of several kinds of actuators which are suitable for the vacuum conditions of space. A master/slave manipulator system that is enhanced by a real-time graphics simulator has also been devised, together with an active-compliance end-effector capable of compensating for a free-flying teleoperator's position errors. The planar, free-flying telerobot is currently under construction. O.C.

A92-53665

WASTE WATER PURIFICATION METHOD USING VAPOR COMPRESSION DISTILLER

KOJI OTSUBO, TOSHIHARU TANEMURA, KEIJI NITTA, MITSUO OGUCHI (National Aerospace Laboratory, Chofu, Japan), HIROSHI KASHIWAGI, and YOSHIO SAWADA (Sasakura Engineering Co., Ltd., Osaka, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1547-1554. refs

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A vapor-compression distiller which uses centrifugal force to separate vapor from liquid is presently considered as a water-recycling system for manned spacecraft. Preliminary performance capability data for such a device were obtained experimentally. It is found that a blower must be adapted to enhance system efficiency, and that both the distillate and the condensed waste water must avoid gas/liquid mixed phases. A suitable method for the cleaning of the inner drum surface must also be devised. O.C.

A92-53666

EVALUATION FOR WASTE WATER PURIFICATION USING THERMOPERVAPORATION METHOD

TOSHIHARU TANEMURA, KOJI OTSUBO, KEIJI NITTA, MITSUO OGUCHI (National Aerospace Laboratory, Chofu, Japan), AKIRA ASHIDA, KENJI MITANI, and NOBUO HAMANO (Hitachi, Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1555-1560. refs

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The thermopervaporation method for recovering purified water from waste water in a manned spacecraft recycling system involves a high molecular weight polymer membrane to induce water vapor. An account is given of the design features and operational characteristics of a laboratory thermopervaporator, as well as the results of a month-long test. It is established that modifications must be made to the membrane element's flowpath shape. O.C.

A92-53667

ADVANCED EXPERIMENTAL MODEL OF WATER DISTILLATION SYSTEM

KENJI MITANI, NOBUO HAMANO, AKIRA ASHIDA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), HIDEAKI KUOKAWA, TOSHIO SAWA (Hitachi, Ltd., Energy Research Laboratory, Japan), KOJI OTSUBO, TOSHIHARU TANEMURA, KEIJI NITTA, and MITSUO OGUCHI (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1561-1564. refs

Copyright

An advanced, thermopervaporation method-based water distiller has been developed which is built up from hollow-fiber modules and achieves exceptionally great compaction. The permeation rate and electrical conductivity values established for the treated water volume are judged to support the feasibility of such a system's use in manned spacecraft. Treated-water purity is found to be sufficiently high for any experimental use currently envisioned, despite a power consumption of less than 1 kW. O.C.

A92-55155#

DEVELOPMENT OF FREE-FLYING SPACE TELEROBOT, GROUND EXPERIMENTS ON 2-DIMENSIONAL FLAT TEST BED

YOSHITUGU TODA, TOSHIKI IWATA, KAZUO MACHIDA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

(Electrotechnical Laboratory, Tsukuba, Japan), AKIKO OTUKA, HIDETOSHI TORIU, YASUO SHINOMIYA (Toshiba Corp., Komukai Works, Kawasaki, Japan), YASUSI FUKUDA, MAKOTO ASAKURA, and NOBUTO MATUHIRA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 1. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 33-39. refs (AIAA PAPER 92-4308) Copyright

This paper describes an ongoing development program for a free-flying space telerobot that can take the place of a human astronaut in extravehicular activities. An inertial navigation system with a linearized control system for maneuvering is adopted. Sensory-feedback techniques are employed for manipulating and handling objects, such as in: (1) arm slew motion with inertial sensors; (2) tracking of grapple fixtures of a target with a vision sensor system; and (3) gently catching and handling targets. The paper gives ground experimental model that works under microgravity conditions on a 2D bed with an air-bearing system.

Author

A92-57213

MODELING OF IMPACT DYNAMICS BETWEEN FREE-FLOATING TARGET AND SPACE ROBOTIC ARM - AN EXTENDED INERTIAL TENSOR APPROACH

KAZUYA YOSHIDA, NAOKI SASHIDA, and YOJI UMETANI (Tokyo Institute of Technology, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p. refs (IAF PAPER 92-0812) Copyright

An extended inertial tensor approach is developed for establishing a basis of impact dynamics for free-floating multibody systems in space. Two new concepts are proposed, both of which are extended versions of the conventional concepts of ground-based robotic arms: the Extended Inversed Inertia Tensor and the Floating Virtual Mass (FVM). Using these concepts, the collision problem is formulated focusing on a velocity relationship just before and immediately after the collision, without sensing the impact force but considering the momentum conservation law. Results of simulations demonstrate that the FVM concept is a useful index for representing the magnitude and the direction of impulsive acceleration. I.S.

N92-12417# Mining and Metallurgical Inst., Hokkaido (Japan).

SURVEY ON POSSIBILITY TO UTILIZE EFFECTIVELY UNDERGROUND SPACE

Mar. 1991 55 p. In JAPANESE (DE92-703044; ETDE/JP-MF-2703044) Avail: CASI HC A04/MF A01

Taking into account the circumstances that underground spaces are utilized effectively for energy and material storage, and as research facilities, a survey was made on the possibility to utilize old mines in closed mines remaining in depopulated areas in Hokkaido. This is a report of the survey carried out by Hokkaido Mine Association on a possibility of effective utilization of underground spaces, to provide a guideline to discussions of regional activation and development of underground spaces in large depths. The report first summarizes the current state of underground space utilization within and without Japan, and provides examples of underground space utilization in Japan. The report then describes the current state of underground space utilization in Hokkaido (closed mines) of metal mines and coal mines. The report further indicates the outlook and problems in effective utilization of the underground spaces (closed mines) in Hokkaido, which could include the use as energy storage, material storage, wastes storage, research facilities, underground factories, mine work training and rescue training center, and for sightseeing. DOE

N92-26954# Niigata Univ. (Japan). Faculty of Engineering. **CATALYTIC WET-OXIDATION OF HUMAN WASTE PRODUCED IN A SPACE HABITAT: PURIFICATION OF THE OXIDIZED LIQUOR FOR HUMAN DRINKING**

Y. TAKAHASHI, N. TAKEDA, T. AOYAGI, and K. TANAKA /n

ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 643-647 Dec. 1991
Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

In order to elucidate the reproducibility and durability of the Ru-Rh catalyst developed formerly for wet oxidation, the filtrate of noncatalytically wet oxidized sewage sludge was wet oxidized again at 300 C using the catalyst. This test was carried out as a batch one and repeated 32 times using only one catalyst. Almost complete oxidation and denitrification occurred regardless of the repetition number. The reproducibility and durability of the catalyst was ensured. In order to reuse the product of the catalytic wet oxidation for hygiene and/or potable water, it was treated by granulated activated carbon and ion exchange resin. Organic matter, conductivity, and color was removed effectively to the levels of potable water. The catalytically wet oxidized liquor can be reused at least for hygiene water. The reuse of potable water is also promising. ESA

N92-26957# National Space Development Agency, Tokyo (Japan).

DESIGN OF JEM TEMPERATURE AND HUMIDITY CONTROL SYSTEM

TADASHI SUZUKI (Tokyo Univ. (Japan).), SYOZO SHIBUTANI (Mitsubishi Heavy Industries Ltd., Hiroshima (Japan).), AKIRA HATTORI (Kawasaki Heavy Industries Ltd., Akashi (Japan).), SABUROU MIWA (Kawasaki Heavy Industries Ltd., Akashi (Japan).), and MASAHARU TAKAGISHI (Kawasaki Heavy Industries Ltd., Gifu, Japan) /n ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 659-664 Dec. 1991

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The design of the Japanese Experiment Module (JEM) to be attached to the Columbus Space Station is addressed. Environmental requirements for two crew members in the module are outlined. The design status of JEM Temperature and Humidity Control (THC) subsystem is described. Design requirements derived from the whole JEM system design are introduced. The THC subsystem and the THC assembly design are presented. Some test results in cabin ventilation testing and component testing are outlined. ESA

N92-27009# Texas Southern Univ., Houston.

AN EVALUATIVE STUDY OF THE SENSORY QUALITIES OF SELECTED EUROPEAN AND ASIAN FOODS FOR INTERNATIONAL SPACE MISSIONS (A FRENCH FOOD STUDY)

S. AHMED and P. V. CORNISH /n ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 1025-1030 Dec. 1991

Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

European and Asian foods for international space missions were investigated by evaluating sensory qualities. Selected Russian, French, Japanese foods were prepared and evaluated by a taste panel for acceptability. Entrees, soups, desserts, vegetables, salads, beverages and snacks were evaluated on the basis of appearance, odor, favor and texture. Food samples were scored on a nine point hedonic scale. The result for the food samples comparatively studied showed significant differences between quality characteristics, foodtypes and compared groups (trained panelist and ethnic panelists) for the Russian and French food samples. The Japanese food samples indicated a significant difference between quality characteristics only at the 0.10 confidence level. Japanese foodtypes and compared groups were significantly different at the 0.05 confidence level. As a result of this study, forty three Russian, thirty five French, and thirty seven Japanese foods were identified as possible candidates for international space missions. ESA

N92-28831# National Aerospace Lab., Tokyo (Japan). Control System Development Team.

THE SECOND FLIGHT SIMULATOR TEST OF THE HEAD-UP DISPLAY FOR NAL QSTOL EXPERIMENTAL AIRCRAFT (ASKA)

KEIJI TANAKA, KENJI YAZAWA, and KAZUYA MASUI Feb. 1991 27 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-633; JTN-92-80351) Avail: CASI HC A03/MF A01

A Head Up Display (HUD) designed by the NAL and manufactured for the NAL Quiet Short Take Off and Landing (QSTOL) experimental aircraft, ASKA, was evaluated for the second time using the STOL flight simulator. The objectives of these simulator tests were: (1) to confirm the display format which was modified after flight test results of the Beechcraft Queen-Air (a NAL research aircraft); (2) to evaluate the radar guidance functions which telelink information displayed in the HUD; and (3) to study the QSTOL's Instrument Flight Rules (IFR) approach capability using the HUD's radar guidance ability. Results of about 300 simulated approach and landing flights which were evaluated by five test pilots showed: (1) display format modifications improved readability and smoothness of the display's motion; (2) the radar guidance algorithm which obtains aircraft position using a tracking radar that is complemented by inertial information was determined to be satisfactory for use in actual flight; and (3) by using the HUD, and especially its indicated runway image, pilots were able to make precise approaches to the runway under Instrument Meteorological Conditions. In addition, other beneficial suggestions for display format final adjustments were obtained prior to HUD's use in the QSTOL flight test series.

Author (NASDA)

N92-33757# Kawasaki Heavy Industries Ltd., Kobe (Japan).

REVIEW ON LIFE SUPPORT TECHNOLOGIES IN EXTRA-VEHICULAR ACTIVITY TECHNOLOGY [SENGAI KATSUDOU GIJUTSU NI OKERU SEIMEI IJI GIJUTSU NO KENTOU]

HIROYUKI TORII In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A03/MF A10

Reviews are conducted of life support systems in space suits for Extra-Vehicular Activity (EVA). The reviews are also conducted for non-decompression type space suits. In non-decompression type suits, the interior pressure is increased and this allows the omission of prebreathing. Reviews are presented for the more fundamental technology of space suits. Technical problems concerning the development of non-decompression type space suits are also reviewed. Topics discussed include the following: carbon dioxide absorbents, the interior pressure of space suits, and oxygen partial pressure meters.

Author (NASDA)

N92-33758# Takenaka Works, Osaka (Japan).

FUNDAMENTAL EXPERIMENTS OF SHOWER DEVELOPMENT FOR SPACE USE [UCHUU YOU SHAWA NO KAIHATSU NI KANSURU KISO JIKKEN]

NORIYUKI TAKAHASHI, KENICHI UNNO, KAORU OOTSUJI (Mitsubishi Heavy Industries Ltd., Tokyo, Japan), and TAKESHI MIYAMOTO (Mitsubishi Heavy Industries Ltd., Tokyo, Japan) In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 8 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A02/MF A10

The problems associated with humans living in space have been investigated during past manned flights. The problems fall into two categories: (1) the effects of microgravity on human physiology; and (2) the problem of closed system substance circulation. The specialized equipment that is necessary for closed system substance circulation (equipment for air and water processing, air conditioning, water supply and drainage, and sanitation) is discussed. Data concerning the behavior of water drops in microgravity conditions were obtained utilizing parabolic flight. There are also problems of physical phenomena which relate to gravity (sedimentation) and convection. These problems are primarily concerned with equipment related to water. Possible

solutions to these problems may make use of centrifugal force or air flow systems.

Author (NASDA)

N92-33780# Nippon Electric Co. Ltd., Tokyo (Japan).

ECLSS EXPERIMENTS AT MANNED LUNAR SURFACE SITES [GETSUMEN YUUJIN KYOTEN NI OKERU ECLSS JIKKEN]

TOSHIMITSU KANEMURA, JUN INAGAKI, and SHIGERU OONO In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 19 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A03/MF A10

Conceptual study of ECLSS (Environmental Control and Life Support System) experiment plans and equipment for developing water recycling technology, one of the technologies which constitute the base for constructing the foundation for enlargement of lunar surface human activities, is conducted. Experiment subjects are as follows: (1) water processing experiments to find out if human waste excreted by the crew can be processed using aerobic microorganisms originally existing in the waste; (2) physical and chemical water processing experiments to conduct tests to verify the drainage processing capability of the water recycling processes focussing on membrane process; and (3) an experiment of substance utilization derived from water recycling process (surplus sludge, concentrated waste). The aim is to bring the material back to earth. Plans of experiments, system concepts, system structures and system flow chart are illustrated, and methods of shipment, operation and maintenance, and safety of the system are outlined. Function and performance of subsystems such as electric power supply, gas supply, control and data processing, thermal control, organism processing, and physical and chemical processing experiment subsystems are also presented.

Author (NASDA)

N92-33782# Toshiba Corp., Tokyo (Japan).

REVIEW ON HABITABILITY AT MANNED LUNAR SURFACE SITES [YUUJIN GETSUMEN KYOTEN NI OKERU KYOJUUSEI NO KENTOU]

KOICHI FURUKAWA In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 15 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A03/MF A10

A review is conducted on the habitability of a module to accommodate the short-time (ten sunlit days, maximum 15 days) stay of three crews at manned lunar surface sites to be used for various experiments and observations. Prerequisites for review are: (1) constructed in around 2010; (2) stay time is ten sunlit days and 15 days at the maximum; (3) constructed at the east side of equator facing at the earth; (4) lunar landing weight per one flight is within ten tons; (5) operation for three years twice per year; (6) consumed materials (water, oxygen, foods, etc.) are expendable; and (7) every crew is given one room. Pressurized module, sizings (constraints by launch vehicles dimensions, ceiling height for expected body statures of white race and the floor spaces and volumes of rooms of the pressurized module), layout, weights and electric power of room spaces of the living module are outlined. Configurations of overall lunar surface sites and living modules are conceptually displayed in drawings.

Author (NASDA)

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A92-20966

SURVIVAL RATES OF SOME TERRESTRIAL MICROORGANISMS UNDER SIMULATED SPACE CONDITIONS

J. KOIKE, T. OSHIMA (Tokyo Institute of Technology, Yokohama, Japan), K. A. KOIKE (Tsukuba University, Japan), H. TAGUCHI, R. TANAKA, K. NISHIMURA, and M. MIYAJI (Chiba University, Japan) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of

55 SPACE BIOLOGY

the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 271-274. Research supported by MOESC. refs Copyright

In connection with planetary quarantine, the survival rates of nine species of terrestrial microorganisms (viruses, bacteria, yeasts, fungi, etc.) are studied under simulated interstellar conditions. If common terrestrial microorganisms cannot survive in space even for short periods, expenditure can be reduced for sterilizing space probes. The interstellar environment in the solar system is simulated by low temperature, high vacuum, and proton irradiation from a Van de Graaff generator. After exposure to a barrage of protons corresponding to about 250 years of irradiation in solar space, tobacco mosaic virus, *Bacillus subtilis* spores, *Aspergillus niger* spores, and *Clostridium manganeti* spores showed survival rates of 82, 45, 28, and 25 percent, respectively. Furthermore, pathogenic *Candida albicans* showed 7-percent survival after irradiation corresponding to about 60 years in space. Author

A92-22103

DIKETOPIPERAZINE-MEDIATED PEPTIDE FORMATION IN AQUEOUS SOLUTION. II - CATALYTIC EFFECT OF PHOSPHATE

O. TAKAOKA, Y. YAMAGATA, and K. INOMATA (Kanazawa University, Japan) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 113-118. refs Copyright

Results are presented from experiments illustrating the catalytic effect of orthophosphate on the condensation reaction between diketopiperazine (DKP) and glycine (Gly) or with oligoglycines (Gly/ $n+2$) producing longer oligoglycines. In the experiments, synthesis of Gly4 and Gly2 was carried out in orthophosphate solutions of various molarity (between 0.06 and 0.24 M), at a neutral pH at 41 C. The yields of Gly4 increased almost linearly with increasing concentrations, up to a yield that was about 100 times higher than in the absence of the orthophosphate. In the case of Gly3, formed from Gly and DKP (glycine anhydride), the yield was only 10 times higher than the absence of orthophosphate. I.S.

A92-44654

CONTRIBUTION OF TEMPERATURE GRADIENT TO AGGREGATION OF THERMAL HETEROCOPOLYMERS OF AMINO ACIDS IN AQUEOUS MEDIUM

EIICHI IMAI, JUN SHIRASAWA, HAJIME HONDA, and KOICHIRO MATSUNO (Nagaoka University of Technology, Japan) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 21, no. 4, 1991-1992, p. 243-249. refs Copyright

The suspension obtained by solubilizing the thermal heterocopolymers of amino acids, aspartic acid, and proline in boiling distilled water was cooled at a controlled rate. The maximum growth of phase-separated microspheres was determined to occur at a finite, nonzero cooling rate; this temperature gradient-controlled growth indicates that the aggregation of thermal heterocopolymers of amino acids in their aqueous milieu is irreversible. Attention is drawn to the significance of such irreversibility to evolutionary theory. O.C.

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MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

A92-17441

INFORMATION PROCESSING TECHNOLOGY IN JAPAN. I

Applied Optics (ISSN 0003-6935), vol. 30, Nov. 10, 1991, p. 4587-4593.

Copyright

Discussions of the New Information Processing Technology project, presented at a workshop held in Hakone, Japan, are summarized. The new information processing initiative is reviewed, with particular attention given to the optical computing and integrated computing parts of the program. O.G.

A92-20683

INFORMATION PROCESSING TECHNOLOGY IN JAPAN. II

Applied Optics (ISSN 0003-6935), vol. 30, Dec. 10, 1991, p. 5106-5110.

Copyright

Some topics discussed at an international symposium on New Information Processing Technologies held in Japan in March 1991 are reviewed. These include the development of massively parallel and distributed hardware with new device technologies, such as optical devices; development of a theory of flexible information processing, parallel and distributed computation, learning and self-organization, and neural and optical computation; and development of a theory and implementation of an integrated information processing model of the brain that can be useful for recognition, understanding, and control in a real world of information, such as control by complex speech input. Other topics discussed include the pros and cons of optical computers, methods of programming massively parallel systems, and ultrafast ultraparallel optoelectronics. V.L.

A92-29014

RESEARCH RESULTS OF THE PROJECT 'HIGH SPEED COMPUTING SYSTEM FOR SCIENTIFIC AND TECHNOLOGICAL USES'

KOICHIRO TAMURA (Electrotechnical Laboratory, Tsukuba, Japan) *International Journal of High Speed Computing* (ISSN 0129-0533), vol. 3, Sept.-Dec. 1991, p. 157-168. refs Copyright

An outline of the Japanese national research project 'High Speed Computing System for Scientific and Technological Uses' is presented in terms of its technological aspects and also its social significance and role. The aim of the project, which started in 1981 and ended in January 1990, was to develop key technologies that would be needed to construct supercomputers in the 1990s. Attention is given to MESFET- and HEMT-type GaAs devices, JJ devices, the SIGMA-1 dataflow system, the PHI, a multiple vector machine, and a satellite imaging processing system. The final system is a scientific demonstration system for testing how the key elementary technologies developed in the project work; its performance was found to be excellent. Significant findings about novel device technologies, parallel architectures, and software were obtained. P.D.

A92-56754#

ROLES OF WIND TUNNEL TESTS AND CFD ANALYSES IN THE DESIGN OF ENERGY-EFFICIENT SST

KOICHI HIRAOA (Kawasaki Heavy Industries, Ltd., Gifu, Japan), HIDEKI NAKANISHI (Mitsubishi Heavy Industries, Ltd., Aichi, Japan), and TAKASHI TSUJIMOTO (Society of Japanese Aerospace Companies, Inc., Tokyo, Japan) *AIAA, Aerospace Ground Testing Conference, 17th, Nashville, TN, July 6-8, 1992*. 7 p. refs (AIAA PAPER 92-3923) Copyright

The dependence of aerodynamic design of the next generation SST on the wind tunnel tests and CFD analyses is discussed. Available CFD codes are assessed in reference to the expected attainable computer power at the early design phase of the next generation SST, which is assumed in this paper to be around the turn of the century. International cooperative facility concept is proposed consisting of new wind tunnel which simulates full flight Reynolds numbers in $M = 1.5 - 3.0$ utilizing all the available advanced technologies, and simulation facility which consists of the most advanced supercomputer and the fully validated CFD softwares. Author

COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

A92-12219

A SPECIAL-PURPOSE COMPUTER FOR GRAVITATIONAL MANY-BODY SYSTEMS - GRAPE-2

TOMOYOSHI ITO, TOSHIKAZU EBISUZAKI, JUNICHIRO MAKINO, and DAIICHIRO SUGIMOTO (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 547-555. Research supported by National Astronomical Observatory. refs
Copyright

GRAPE-2, the second experimental machine for gravitational many-body systems, which is designed to calculate the dynamical evolution of astronomical collisional systems requiring an accuracy higher than that provided by GRAPE-1, is presented. GRAPE-2 has a word length of 32/64 bits and calculates gravitational forces at a speed of 40 Mflops. Consideration is given to its pipeline unit, communications, packaging, performance, Aarseth scheme, tree code, and future prospects. C.A.B.

A92-25641

IMAGE LOGIC ALGEBRA AND ITS OPTICAL IMPLEMENTATIONS

MASAKI FUKUI and KEN-ICHI KITAYAMA (NTT, Transmission Systems Laboratories, Yokosuka, Japan) Applied Optics (ISSN 0003-6935), vol. 31, Feb. 10, 1992, p. 581-591. refs
Copyright

A generic language for optical parallel processing image logic algebra (ILA), is proposed. In ILA a neighborhood configuration pattern (NCP) is introduced, and image transformations are defined by the use of NCP operations. The comprehensive relationship of ILA to symbolic substitution, optical array logic, mathematical morphology, and binary image algebra are clarified. Furthermore, an architecture that is suited for ILA and its optical implementations is proposed. Author

A92-29015

FUJITSU VP2000 SERIES SUPERCOMPUTERS

NOBUO UCHIDA (Fujitsu, Ltd., Main Frame Div., Kawasaki, Japan) International Journal of High Speed Computing (ISSN 0129-0533), vol. 3, Sept.-Dec. 1991, p. 169-185. refs
Copyright

The demand for high-performance supercomputers has been growing rapidly in the scientific and engineering fields. To meet this demand, Fujitsu has developed new pipelined supercomputers, the VP2000 series, which attain a maximum performance of up to 5 GFLOPS. This paper describes the VP2000 series in the following areas: architecture, hardware features, hardware technology, multiprocessor system, and software features. Author

A92-33883

GRAPE-1A - SPECIAL-PURPOSE COMPUTER FOR N-BODY SIMULATION WITH A TREE CODE

TOSHIYUKI FUKUSHIGE, TOMOYOSHI ITO, JUNICHIRO MAKINO, TOSHIKAZU EBISUZAKI, DAIICHIRO SUGIMOTO (Tokyo, University, Japan), and MASAYUKI UMEMURA (National Astronomical Observatory, Mitaka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 841-858. refs
(Contract MOESC-02740131)
Copyright

GRAPE (GRAvity Pipe)-1A, a special-purpose computer for N-body simulations, has been developed using the $O(N \log N)$ tree code. GRAPE-1A calculates the gravitational force between particles. The peak speed of GRAPE-1A is equivalent to 240 Mflops. The effective speed is over 200 Mflops for the direct summation, and around 80 Mflops for the tree algorithm. Using GRAPE-1A

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and the modified tree algorithm code, one time step takes 2 s for $N = 4096$ and 20 s for $N = 32768$. GRAPE-1A can complete either a simulation of interacting galaxies or a cosmological simulation within one week. GRAPE-1A can be also applied to particle-based hydrodynamical simulations such as smoothed-particle hydrodynamics (SPH). The performance of GRAPE-1A is comparable to that of a supercomputer with a peak-speed of 500 Mflops for any type of the direct summation, the modified tree algorithm, and SPH. Author

A92-38956

DIGIT-PIPELINED ON-CHIP CLIQUE-FINDING VLSI PROCESSOR FOR REAL-TIME 3-D OBJECT RECOGNITION

T. HANYU, T. KODAMA, and T. HIGUCHI (Tohoku University, Sendai, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 8, April 9, 1992, p. 722-724. refs
Copyright

A new on-chip clique-finding VLSI processor is proposed for high-speed graph matching. Using VLSI arrays with the encoded information of all the vertices, the breadth-first search algorithm that finds corresponding vertices between two graphs can be performed in a digit-level pipelining manner. The effect of the digit-pipelined architecture is evaluated. Author

COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms, and specific applications, e.g., CAD/CAM.

A92-10107

STUDIES ON ROBOT PROGRAMMING SYSTEM BASED ON THE OBJECT-ORIENTED MODELS

TOSHIHIRO MATSUI Electrotechnical Laboratory, Researches (ISSN 0366-9106), no. 926, April 1991, 173 p. In Japanese. refs

The construction of an integrated and generic robot programming system that can be applied to many types of robots and tasks is discussed. The system is implemented on an object-oriented basis since an object is one of the most general and powerful vehicles to carry information on many aspects of models, and the inheritance mechanism of object-oriented systems has characteristics that permit integration of many modules. A new robot teleoperation scheme based on the integration of environment modeling, robot task programming, motion simulation, and execution monitoring is discussed. A new visual man-machine interfacing device developed in order to realize this scheme is described. C.D.

A92-14535

AUTOMATIC TWO- AND THREE-DIMENSIONAL MESH GENERATION BASED ON FUZZY KNOWLEDGE PROCESSING TECHNIQUE

G. YAGAWA, S. YOSHIMURA (Tokyo, University, Japan), N. SONEDA (Central Research Institute of Electric Power Industry, Tokyo, Japan), and K. NAKAO (Tokyo, University, Japan) IN: Computers in engineering 1990; Proceedings of the ASME International Computers in Engineering Conference and Exposition, Boston, MA, Aug. 5-9, 1990. Vol. 2. New York, American Society of Mechanical Engineers, 1990, p. 107-114. Research supported by MOESC. refs
Copyright

The present automated FEM mesh-generation system, which has its basis in fuzzy knowledge processing, stores a number of local-optimum nodal patterns for stress concentration fields around cracks, corners, holes, etc. in a nodal-pattern data base. The 'closeness' of each nodal location to the stress-concentration field is expressed in terms of a membership function that is employed in the fuzzy-knowledge processing. The ambiguity that arises in mesh-generation processes is taken directly into account; in

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addition, while inputting fewer data, a user can generate a quasi-global-optimum mesh for an entire analysis domain (including several stress-concentration fields). O.C.

A92-17322

TREECODE WITH A SPECIAL-PURPOSE PROCESSOR

JUNICHIRO MAKINO (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 621-638. refs
Copyright

An implementation of the modified tree algorithm of Barnes-Hut (1986, 1989) for a gravitational N-body calculation on a Gravity Pipe (GRAPE) backend processor is described. It receives the positions and masses of particles from a host computer and then calculates the gravitational force at each coordinate specified by the host. In the present modified algorithm, a list of nodes for many particles is created, significantly reducing the amount of work required by the host. The computing time of the force calculation becomes comparable to that of the tree construction, if the GRAPE processor is sufficiently fast. The obtained speed-up factor is 30 to 50 for an RISC-based host computer and GRAPE-1A with a peak speed of 240 Mflops. P.D.

A92-19126

ANALYSIS OF PARALLELISM IN AUTONOMOUS EXECUTION OF DATA-FLOW PROGRAM NETS

QI-WEI GE, TOSHIMASA WATANABE, and KENJI ONAGA (Hiroshima University, Japan) (Institute of Electronics, Information and Communication Engineers of Japan and Korean Institute of Telematics and Electronics, 1990 Joint Technical Conference on Circuits/Systems, Computers and Communications, Cheju, Republic of Korea, Dec. 11, 12, 1990) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3008-3017. Research supported by Telecommunications Advancement Foundation, CSK, and Murata Manufacturing Co., Ltd. refs
(Contract MOESC-02302047; MOESC-02248109)
Copyright

A definition of parallel degree (called PARAdeg) is proposed to theoretically evaluate the parallelism of data-flow program nets. Algorithms for computing PARAdeg for acyclic SWITCH-less nets are presented. PARAdeg can be used for the estimation of the number of processors required to run a given program net with a reasonable speedup. O.G.

A92-19128

A FORTRAN PARALLELIZING COMPILATION SCHEME FOR OSCAR USING DEPENDENCE GRAPH ANALYSIS

HIRONORI KASAHARA, HIROKI HONDA, and SEINOSUKE NARITA (Waseda University, Tokyo, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3105-3114. refs
Copyright

A FORTRAN parallelizing compilation scheme is proposed for a multiprocessor system named OSCAR. This hierarchical processing scheme combines the macrodataflow computation, loop concurrentization, and near fine grain processing. Parallelism among the coarse grain tasks called macrotasks is detected by analyzing a macroflow graph which explicitly represents control flow and data dependences. The detected parallelism among the macrotasks is represented by a directed acyclic graph called a macrotask graph. A macrotask composed of a Do-all loop or a Do-across loop, which is assigned onto a processor cluster, is processed in the medium grain in parallel by processors inside the processor cluster. A macrotask composed of a basic block is processed on a processor cluster in the near fine grain by using static scheduling. It is concluded that the hierarchical parallel processing scheme based on dynamic and static scheduling effectively exploits parallelism from FORTRAN programs. O.G.

A92-19129

VERIFICATION OF ERROR RECOVERY SPECIFICATION FOR DISTRIBUTED DATA BY USING COLORED PETRI NETS

MASAHARU AKATSU, TOMOHIRO MURATA, and KENZO KURIHARA (Hitachi, Ltd., Systems Development Laboratory,

Kawasaki, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3159-3167. refs
Copyright

A colored Petri net model for a data renewal sequence, including failure events, is proposed for systems where the same data are distributed in plural memories. Introduction of the equivalence relation into a set of reachable states reduced the number of states to be verified. It is concluded that the model is helpful in verifying the data consistency and designing error recovery to avoid the false-data-change. The approach was applied to read/write control of a disk controller with a built-in cache memory. O.G.

A92-19141

FIHT2 ALGORITHM - A FAST INCREMENTAL HOUGH TRANSFORM

HIROYASU KOSHIMIZU (Chukyo University, Toyota, Japan) and MUNETOSHI NUMADA (Lossev Technology Corp., Toyama, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3389-3393. refs
(Contract MOESC-01550293; MOESC-02650277)
Copyright

FIHT2, a new Hough transform (HT) algorithm, is proposed. It is shown that FIHT2 is capable of providing a marked reduction of the computation cost. It does not require any other operations than the incremental addition operations. It is suggested that the algorithm can be used in conjunction with some other algorithms for the reduction of 'frequency cost' in order to further reduce the computation cost. O.G.

A92-19142

FAULT TOLERANT PROCESSOR ALLOCATION IN HYPERCUBE MULTIPROCESSORS

DUSAN JOKANOVIC, NORIO SHIRATORI, and SHOICHI NOGUCHI (Tohoku University, Sendai, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3492-3505. refs
Copyright

A fault-tolerant allocation algorithm is proposed which reconstructs allocation list in order to remedy damage caused by faults. This two-step algorithm builds a new allocation list with improved subcube recognizability. The number and/or size of fault-free recognizable subcubes on the new list are maximal for the given distribution of faults. Such degradation of allocation performance in injured hypercube is achieved just by means of processor readdressing. O.G.

A92-19407

AEROSPACE SOFTWARE ENGINEERING IN JAPAN

HIROSHI MIZUTA (NASDA, Tokyo, Japan) IN: Aerospace software engineering - A collection of concepts. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1991, p. 581-591. refs
Copyright

Aerospace software engineering activities at the National Space Development Agency of Japan (NASDA) are discussed. Emphasis is placed on business activities which have a strong impact on the development of software support environments in aerospace systems. Particular attention is given to the Software Industrialized Generator and Maintenance Aids (SIGMA) project aimed at providing a national network supporting the development of interoperable software. O.G.

A92-19832

STATE OF THE ART OF THE DATABASES AND SOFTWARES ON THE FATIGUE AND CRACK PROPAGATION IN JAPAN

KEISHI KAWAMO (Mitsubishi Research Institute, Inc., Tokyo, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2449-2459. refs
Copyright

Recently, an increasing number of databases have been

constructed at national research institutions, academic societies, and private companies concerning fatigue and crack-propagation in metallic materials. The main purposes are: (1) to compile data; (2) to use data for the fatigue design, lifetime prediction of structure and machinery; and (3) for raising efficiency of fatigue and crack-propagation tests. Softwares are developed and used at the same time in order to help to use database and achieve their specific purposes. With the advance of the practical use of artificial intelligence, expert systems are being included in these softwares. Author

A92-23694

VERIFICATION OF PRACTICAL RULE-BASED SYSTEMS FOR SPACE

TOMIHIRO TAKANO, KEINOSUKE MATSUMOTO, SHIGEKI KUZUOKA, and EIICHI OGAWA (Mitsubishi Electric Corp., Amagasaki, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 189-192. refs

This paper proposes an approach to automatically verify rule-based expert systems developed for space in which no system errors can be permitted. The problem of detecting bugs in developed rule-based systems is mentioned. A dynamic verification method of rule-based systems is proposed. This method enables the detection of system errors automatically by making rule-based systems infer and by watching over their reasoning process. To realize this method, a verifying module is developed. This traces the reasoning process by watching systems working memory, which is the storehouse of reasoning results. The system specification is transformed into the constraints to the working memory and adopt them as evaluation criteria of inference. Author

A92-23701

INFORMATION-CONTROL ARCHITECTURE FOR SPACE AUTOMATION AND ROBOTICS SYSTEM

KOHJI KAMEJIMA, TOMOYUKI HAMADA, IKUO TAKEUCHI (Hitachi, Ltd., Mechanical Engineering Research Laboratory, Ibaraki, Japan), KENJIRO KUMAMOTO, and SHIN'ICHI TAKARADA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 221-224. refs

An information-control architecture is presented for interactive operation of autonomous space robotics systems. Knowledge representation of environment and manufacturing step is introduced as a basis for monitoring and command in ground facilities. A perception-control mechanism is designed for onboard adaptation of instructions transmitted from the ground facilities. The architecture is verified with experiments using a prototype. Author

A92-27744

GRAY-IMAGE PROCESSING USING OPTICAL ARRAY LOGIC

SUNAO KAKIZAKI (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), JUN TANIDA, and YOSHIKI ICHIOKA (Osaka University, Suita, Japan) Applied Optics (ISSN 0003-6935), vol. 31, March 10, 1992, p. 1093-1102. refs

Copyright

A method for digital image processing that uses optical array logic (OAL) is presented. Parallel thresholding and digital filtering are demonstrated. OAL is a promising computational paradigm for digital optical computing based on parallel neighborhood operations for two two-dimensional binary images. In the proposed method, virtual processing elements are assumed on an image plane and a gray pixel in an original gray image is stored in each processing element. Efficient gray-image processing can be achieved by data manipulation in the virtual processing elements and in the data communication among them by using OAL. Several simulation results are presented. Finally, hardware requirements for the developed algorithms and their capabilities are discussed. Author

A92-33884

A MODIFIED AARSETH CODE FOR GRAPE AND VECTOR PROCESSORS

JUNICHIRO MAKINO (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 859-876. refs

Copyright

The performance of a hierarchical timestep algorithm, which is Aarseth's individual timestep algorithm for N-body problems modified for use with GRAPE hardware and/or vector processors, is discussed. In Aarseth's original algorithm, each particle has its own time and timestep. At each integration step, only one particle is updated. To obtain the force on that particle, the positions of all other particles at its time are predicted. The total speed is limited by the speed of the host computer. In the hierarchical timestep algorithm, several particles are updated simultaneously. Therefore, the positions of other particles are predicted only once for these particles. In order to update several particles the timesteps of particles are organized in a hierarchy, where timesteps are 'quantized' to powers of two. Author

A92-38320

1991 INTERNATIONAL CONFERENCE ON COMPUTER PROCESSING OF CHINESE AND ORIENTAL LANGUAGES, TAIPEI, REPUBLIC OF CHINA, AUG. 13-16, 1991, PROCEEDINGS

Conference sponsored by Chinese Language Computer Society, National Tsing Hua University, Ministry of Education of the Republic of China, et al. Yorktown Heights, NY, Chinese Language Computer Society, 1992, 360 p. No individual items are abstracted in this volume.

Copyright

Consideration is given to the structure and function of the EDR electronic dictionaries; conversion of phonetic-input to Chinese text through constraint satisfaction; screen fonts for Chinese windowing systems, automatic translation and input/output methods; multi-language document recognition; an efficient and intelligent Chinese linguistic decoding system for very large vocabulary Mandarin speech recognition; segmentation and classification of documents with text, diagrams, and images; and an efficient spectral smoothing technique for an analysis-synthesis speech coder. Attention is also given to parallel thinning algorithms, speaker adaptation based on a hidden Markov model, machine translation of Chinese to English using linguistic canonical forms, the CTRDL rule description language in machine translation system, large vocabulary Mandarin tone recognition, a practical speech recognition system, Chinese form preprocessing for automatic data entry, and internationalization and localization on UNIX System V. O.G.

A92-43130

THE MISSILE AERODYNAMIC CONFIGURATION DESIGN AND ASSESSMENT SYSTEM (MACDAS), VERSION 1

FUMIAKI IMADO, TAKESHI KURODA (Mitsubishi Electric Corp., Amagasaki, Japan), and S. KANDA (Fujitsu Research Institute, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 168-171. In Japanese. refs

The operational procedures and structures of MACDAS are presented. The functions and characteristics of the systems are illustrated. Y.P.Q.

A92-51591

ASSOCIATIVE MEMORY IN A CYCLIC NEURAL NETWORK

JIFENG SUN and TADASHI NAGATA (Kyushu University, Fukuoka, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 52, no. 1, March 1992, p. 85-94. refs

Pattern orthogonalization extension or high correlation is introduced in the cyclic neural network. The pattern orthogonalization extension by the power product sets of the original patterns can change nonorthogonal patterns to orthogonal or near-orthogonal vectors, which are easy to be stored. The

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storage capacity and the storage effectiveness of the cyclic neural network are shown to be higher than those of a two-layer BAM network due to the pattern orthogonalization extension. Author

A92-56113

A DEVELOPMENT OF HYPERMEDIA TYPE DATABASE SYSTEM FOR INSTRUCTION OF AIRCRAFT CONCEPTUAL DESIGN

YOSHISADA MUROTSU, SHOWZOW TSUJIO, and CHOONG S. PARK (Osaka Prefecture University, Sakai, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 506-510. In Japanese. refs

A database system is developed for instruction in aircraft conceptual design. The system is a hypermedia type database which stores and manages various kinds of design information, i.e., numerical data, documents, graphs, drawings, and so on. The system is programmed based on an object-oriented approach.

Author

N92-15608# Japan Atomic Energy Research Inst., Tokyo.

SPEEDUP OF MCACE, A MONTE CARLO CODE FOR EVALUATION OF SHIELDING SAFETY, BY PARALLEL COMPUTER. 1: PARALLELING OF MCACE CODE AND PERFORMANCE EVALUATION BY SIMULATOR

AKEMI KAWAZOE (Japan Atomic Energy Research Inst., Tokyo.), KAZUYOSHI MINAMI (Fujitsu Ltd., Tokyo, Japan), MAKOTO TAKANO (Japan Atomic Energy Research Inst., Tokyo.), FUMIHIRO MASUKAWA (Japan Atomic Energy Research Inst., Tokyo.), and YOSHITAKA NAITO Apr. 1991 83 p In JAPANESE; ENGLISH summary

(DE91-508295; JAERI-M-91-066) Avail: CASI HC A05/MF A01

In order to improve the accuracy of shielding analysis, we have modified MCACE, a Monte Carlo code for shielding analysis, to enable execution on a parallel computer. The suitable algorithms for efficient paralleling has been investigated by static and dynamic analyses of the code. This includes a strategy where new units of batches are assigned to the idling cells dynamically during the execution. The efficiency of paralleling has been measured by using a simulator of a parallel computer. It is found that the load factor of all cells reached nearly 100 percent, and consequently, it can be said that the most effective paralleling has been achieved. The simulator has estimated the effect of paralleling, at a speedup of 7.13 times, when a sample problem of 8 batches, 400 particles per one batch, is loaded on a parallel computer equipped with 8 cells. DOE

N92-18107# National Aeronautical Lab., Tokyo (Japan). Computational Sciences Div.

VECTOR PROCESSING TIME CHART ANALYSIS PROGRAM (VTAP) SIMULATION OF VECTOR PROCESSING COMPUTERS

HAJIME MIYOSHI, HARUO HATAMA, and YUKIHIRO KARUBE Feb. 1991 29 p In JAPANESE; ENGLISH summary (ISSN 0389-4010)

(NAL-TR-1094) Avail: CASI HC A03/MF A01

The Vector Processing Time Chart Analysis Program (VTAP) is a software simulator used to simulate the Vector Processing (VP) of the Fujitsu VP series and other similar computers. This simulator enables the development of enhanced compiler technology and user programming skills, while also advancing data acquisition for the development of new vector computers. Both the VP series' hardware and operations are discussed, with the corresponding VTAP functions and simulation contents being explained. VTAP simulation accuracy was investigated by comparing the VTAP estimated program processing time with the measured time in the VP400 and VP200 models. The obtained VTAP simulation accuracy was 94.5 percent for the VP400 and 98.8 percent for the VP200 simulations. Author

N92-19649# Meteorological Satellite Center, Tokyo (Japan). **A LOCATION ALGORITHM OF ARGOS DATA COLLECTION PLATFORM**

YOSHIAKI TAKEUCHI In its Meteorological Satellite Center

Technical Note No. 20, 1990 p 1-9 Mar. 1990 In JAPANESE; ENGLISH summary

Avail: CASI HC A02/MF A02

A location algorithm for ARGOS Data Collection Platform (DCP) was developed. DCP messages extracted from High Resolution Picture Transmission (HRPT) data included several sets of signal-reception time and Doppler shifted frequency. Least-squares method was applied to these data to locate the DCP. Since two numerical solutions for one DCP location were usually obtained, a true position must be determined by comparison with the previously obtained DCP location. Results were validated with ancillary parameters such as iteration times, distance between obtained pair positions, residual of received frequency in least-squares computation, the number of messages, etc. In the case of fixed platforms, it is shown that the position derived from only well-checked data has the RMS accuracy of 3 km. Derived positions and velocities of floating buoys give valuable information of ocean current in the data sparse region. Author

N92-19651# Meteorological Satellite Center, Tokyo (Japan).

ON ENHANCEMENT DISPLAYING OF GMS IMAGE

TOMOYUKI HARADA In its Meteorological Satellite Center Technical Note No. 20, 1990 p 23-32 Mar. 1990 In JAPANESE; ENGLISH summary Original contains color illustrations

Avail: CASI HC A02/MF A02

The visual enhancement technique in displaying Geostationary Meteorological Satellite (GMS) image data using a man-machine interactive computer system at the MSC is developed. There are three enhancement techniques: to enhance the observed brightness temperature with the gray density; to enhance with pseudocolor; and to enhance with stereographic presentation. These techniques are introduced to the routine operation for determination of the cloud system center of tropical cyclone as from 1987 typhoon season. Author

N92-20253# Florida State Univ., Tallahassee. Dept. of Computer Science.

JAPANESE ADVANCES IN FUZZY SYSTEMS AND CASE-BASED REASONING

D. G. SCHWARTZ Nov. 1991 52 p

(PB92-115443) Avail: CASI HC A04/MF A01

A survey and assessment is presented of fuzzy systems and case based reasoning research in Japan. Fuzzy logic controllers are examined. Other developments are surveyed on activities at various societies, research institutes, universities, and corporate labs. Current activity in case based reasoning is also surveyed. A few summary reflections are offered, including conjectures on why the Japanese have outstripped their western counterparts in this domain, together with some suggestions on what the U.S. might do to catch up. An appendix contains a bibliography of all materials collected by the author, plus names and addresses of most of the people he met. Author

N92-20549*# Research Inst. for Advanced Computer Science, Moffett Field, CA.

EXPERT SYSTEM VERIFICATION AND VALIDATION STUDY. DELIVERY 3A AND 3B: TRIP SUMMARIES

SCOTT FRENCH (International Business Machines Corp., Houston, TX.) 23 Aug. 1991 15 p

(Contract NCC9-16; RICIS PROJ. AL-16)

(NASA-CR-189942; NAS 1.26:189942) Avail: CASI HC A03/MF A01

Key results are documented from attending the 4th workshop on verification, validation, and testing. The most interesting part of the workshop was when representatives from the U.S., Japan, and Europe presented surveys of VV&T within their respective regions. Another interesting part focused on current efforts to define industry standards for artificial intelligence and how that might affect approaches to VV&T of expert systems. The next part of the workshop focused on VV&T methods of applying mathematical techniques to verification of rule bases and techniques for capturing information relating to the process of developing software. The final part focused on software tools. A summary is also presented

of the EPRI conference on 'Methodologies, Tools, and Standards for Cost Effective Reliable Software Verification and Validation. The conference was divided into discussion sessions on the following issues: development process, automated tools, software reliability, methods, standards, and cost/benefit considerations.

E.R.

N92-23266# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

THE 7TH INS SCIENTIFIC COMPUTATIONAL PROGRAMS

Jul. 1991 83 p In JAPANESE; ENGLISH summary (DE92-750967; INS-T-503) Avail: CASI HC A05/MF A01

Nineteen groups were accepted at the 7th INS Scientific Computational Programs (ISCP). This ISCP can use full resources of the INS central computer without an operational limitation. The 7th ISCP started on June 11, 1991 and ended on March 30, 1991. Some results were already published in journals or appeared in physical meetings. This is a sum of the used statistics of the 7th ISCP and reports presented by groups performed the 7th ISCP.

DOE

N92-32874*# Osaka Univ. (Japan). Faculty of Engineering Science.

BETTER PREDICTIONS EVEN IN REDUCED INPUT VARIABLE NUMBERS USING NEURAL NETWORKS IN SOFTWARE DEVELOPMENT

YOSHIHIRO TAKADA, MARGARET C. THOMPSON, and KOJI TORII /n NASA. Goddard Space Flight Center, Proceedings of the Sixteenth Annual Software Engineering Workshop p 103-120 Dec. 1991

Avail: CASI HC A03/MF A03; NASA Goddard Space Flight Center, Code 552, Greenbelt, MD 20771 HC

A quantitative approach in software engineering, in which various aspects of the software process and products are measured and used to guide the software engineering process, is becoming important. This paper presents a framework for developing prediction models using artificial neural networks. In this method, an initial model is generated on a neural network with an initial set of data with input for all variables for which data is available. The contribution measure for a variable is an estimation of the square increase in prediction error when that variable is removed from the set of inputs. Variables are eliminated as long as prediction remains sufficiently accurate.

H.A.

N92-32879*# International Business Machines Corp., Poughkeepsie, NY.

A STUDY OF LARGE SCALE SOFTWARE TESTING

MITSURU OHBA and VICTOR R. BASILI (Maryland Univ., College Park.) /n NASA. Goddard Space Flight Center, Proceedings of the Sixteenth Annual Software Engineering Workshop p 175-207 Dec. 1991 Prepared in cooperation with IBM Japan

Avail: CASI HC A03/MF A03; NASA Goddard Space Flight Center, Code 552, Greenbelt, Md 20771 HC

Summarized here are the results of a study done in the United States and a comparison with state-of-the-practice software testing in large scale system software development projects in Japan. The primary observations were that those who participate in these projects are as good as the people who participate in similar projects in Japan, that there is a difference in emphasis on testing, that there is a significant difference in the use of measurements for process improvements between the U.S. and Japan, and that there are differences in development and deployment of common techniques and standard tools.

Author

N92-70035 Office of Science and Technology, Washington, DC. **FEDERAL COORDINATING COUNCIL, SCIENCE, ENGINEERING, AND TECHNOLOGY, SUBCOMMITTEE ON SCIENCE AND ENGINEERING COMPUTING Annual Report, FY 1989**

1989 55 p (PB91-124453) Avail: CASI HC A04/MF A01

The Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) is an interagency body which was

established to address policy matters involving more than one agency, to plan programs, identify needs, and promote international cooperation in science and technology. Standing committees were established to assist the FCCSET in carrying out specific tasks. The committees consist of experts from relevant agencies. The Annual Report of the Subcommittee on Science and Engineering Computing of the FCCSET Committee on Computer REsearch and Applications is presented. The following subject areas are covered: FCCSET strategic computing initiative; high performance computer implementation plan; the supercomputer industry; U.S. technology developments; Japanese market issues; and U.S.-Japanese S&T agreement meetings.

Author

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COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

A92-12195

PERFORMANCE ANALYSIS OF PARALLEL PROCESSING WITH CONSIDERING DATA INPUT/OUTPUT

HIROHIKO TASHIRO and YOSHIMITSU TAKASAWA University of Electro-Communications, Bulletin (ISSN 0915-0935), vol. 4, June 1991, p. 105-114. In Japanese. refs

In a parallel processing system, it is desirable that the speed-up rate increases proportionally to the number of processors. Practically it is impossible because interprocessor communication and data input/output waste execution time and executing speed slow down. The performance of paralleled FFT considering data input/output on loosely coupled systems is discussed, and performance evaluations of paralleled FFT on a transputer network are presented. It is concluded that the performance of parallel processing depends on a size of data input/output.

Author

A92-15332

A DEVELOPMENT OF COMPUTER SUPPORT SYSTEM FOR WING DESIGN

Y. MUROTSU, C. S. PARK (Osaka Prefecture, University, Sakai, Japan), and M. ICHIKAWA (Japan Research Institute, Ltd., Osaka, Japan) Chinese Journal of Aeronautics (ISSN 1000-9361), vol. 4, May 1991, p. 141-149. refs

Copyright

Since it takes a long time to design an aircraft, the succession to or the acquirement of knowledges and technologies is a key to provide to aircraft design high quality and productivity. The paper describes a computer support system for wing design using a new tool based on an object-oriented approach. The system is programmed in a module of objects which represent design tasks or design knowledges. The modulated program gives advantages to maintain and extend the system easily. The system provides to users a flexible support with excellent user interface which consists of a mouse, a menu-driven system, and a window system.

Author

A92-17323

DREAM - A SPECIAL-PURPOSE COMPUTER FOR LARGE SCALE MESH CALCULATIONS

JUNICHIRO MAKINO, TOSHIKAZU EBISUZAKI, and SACHIKO K. OKUMURA (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 639-648. refs

Copyright

The concept of DREAM (Disk Resource Array Machine), a computer designed for large-scale simulations using finite-difference grids, is presented. The DREAM system uses an array of magnetic disks as the main memory instead of silicon solid-state memory chips. The machine offers a 100-times larger memory for the same cost. In the DREAM architecture, a number

62 COMPUTER SYSTEMS

of disks are accessed in parallel in order to achieve a high data-transfer rate. The access time of a disk is about 100,000 times longer than that with a silicon memory. The feasibility of building a highly parallel DREAM system with a main storage exceeding 1 T bytes is addressed. DREAM is compared with present supercomputers, which have a potentially fairly large transfer rate between the main memory and the disks. It is shown that the DREAM system offers both expandability to a larger system and a better price-performance ratio. The possibility of applying DREAM to other fields, such as the reduction of observational data, is explored. P.D.

A92-19525

HYBRID SYSTOLIC SORTERS

SUSUMU HORIGUCHI (Tohoku University, Sendai, Japan) Parallel Computing (ISSN 0167-8191), vol. 17, Nov. 1991, p. 997-1007. refs

(Contract MOESC-02805042)

Copyright

Area performance of systolic sorters is investigated by introducing the river routing model. Three kinds of systolic sorters, Batcher's bitonic sort, Stone's shuffle sort, and odd-even transposition sort on a mesh-connected array, are discussed. It is pointed out that the area performance of systolic sorters is dominated by wiring space between cells. To remedy the synchronization problem due to the clock skew, a hybrid sorter and a recirculating hybrid sorter are proposed here. It is confirmed that the recirculating hybrid sorter is reconfigurable and suitable for WSI implementation. Author

A92-22890

CASCADE-CONNECTIVE OPTICAL PARALLEL LOGIC PROCESSOR USING ELECTROPHOTONIC DEVICES

SHIGERU KAWAI, YOSHIHARU TASHIRO, HIDEO ICHINOSE, and KENICHI KASAHARA (NEC Corp., Kanagawa, Japan) Applied Optics (ISSN 0003-6935), vol. 31, Jan. 10, 1992, p. 178-185. refs

Copyright

To perform image or arithmetic processing optically, it is necessary that a large number of required optical processors be connected in a series. For such cascade connections, however, coding and decoding processes are undesirable because of the necessity for the complicated hardware that often results. A new logic algorithm for application to cascade connections is proposed which utilizes, in place of coding and decoding processes, true logic signals and their complements. Its optical implementation is also discussed. A processing module is constructed from electrophotonic devices referred to as vertical to surface transmission electrophotonic devices, a ferroelectrical liquid-crystal spatial light modulator, and a planar microlens array. Its logic operations are successfully demonstrated. Author

A92-26223

NEC SUPERCOMPUTER SX-3 SERIES ARCHITECTURE AND SOFTWARE

AKIHIRO IWAYA (NEC Corp., Tokyo, Japan) IN: Computing methods in applied sciences and engineering; Proceedings of the 9th International Conference, Paris, France, Jan. 29-Feb. 2, 1990. Philadelphia, PA, Society for Industrial and Applied Mathematics, 1990, p. 353-359.

Copyright

The NEC SX-3 series architecture and software are briefly reviewed. The SX-3 series basic design approach is to pursue the ultimate scalar performance of a single processor and vector processing capability. It is noted that silicon VLSI and high-density packaging technologies are the major technological contributions to the realization of this multiprocessor system. O.G.

A92-29855#

PRELIMINARY ASPECTS OF A GLOBAL MESSAGE NETWORK EMPLOYING LOW EARTH-ORBITING SATELLITES

JAIDEV KANIYIL, JUN TAKEI, SHIGERU SHIMAMOTO, YOSHIKUNI ONOZATO, TOMONORI USUI (University of

Electro-Communications, Tokyo, Japan), IKUO OKA (Osaka City University, Japan), and TSUTOMU KAWABATA (University of Electro-Communications, Tokyo, Japan) IN: AIAA International Communication Satellite Systems Conference and Exhibit, 14th, Washington, DC, Mar. 22-26, 1992, Technical Papers. Pt. 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1992, p. 876-884. refs

(AIAA PAPER 92-1926) Copyright

A world-wide message communication network, employing satellites at low altitudes, is the subject of this paper. This network can afford 24 hours service to any part of earth, including the polar regions. The oblate globe is modeled as a regular polyhedron over the surface of which satellites move in low altitude, symmetrical orbits. Considering the method of access over the cross-links to be the slotted ALOHA scheme, the performance parameters of a homogeneous network are estimated. Simulation results are found to agree with the estimation at low levels of offered load over the up-link. Author

A92-43250

REAL-TIME PARALLEL ARCHITECTURE FOR SENSOR FUSION

TOSHIO SHIMADA, KENJI TODA, and KENJI NISHIDA (Electrotechnical Laboratory, Tsukuba, Japan) Journal of Parallel and Distributed Computing (ISSN 0743-7315), vol. 15, no. 2, June 1992, p. 143-152. Research supported by Science and Technology Agency of Japan. refs

Copyright

The vast computational requirements of fused-sensor-related data processing entail implementation on a parallel architecture capable of real-time computation. Attention is presently given to such an architecture, which employs processors that are tightly coupled with a priority-handling network. This prioritized multistage network avoids the priority-inversion problem and renders process execution times predictable. The processor employs two pipelines, one of which executes the highest-priority process, while the other handles inserted instructions and administration during the next-highest-priority process' execution. O.C.

A92-53596

INTEGRATED SYSTEM TO SUPPORT COMPUTER ANALYSIS IN CONCEPTUAL AEROSPACE DESIGN

H. YAMAMOTO, K. MATSUSHIMA, M. NAKA, K. MATSUMOTO (National Aerospace Laboratory, Chofu, Japan), Y. SATO, K. HARADA (Fujitsu Laboratories, Ltd., Kawasaki, Japan), and M. KAWAI (Facom-Hitac, Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1039-1043. refs

Copyright

This paper describes a knowledge-based system to support designers and improve the efficiency of design analysis. The system provides designers with information to analyze a problem and extract desired output by using the expertise accumulated in the system. Knowledge base, engineering database, and program library are all combined in an object-oriented expert shell. This system has been constructed based on the three concepts: I/O data and programs are separated and can be registered in the separate tree-structured databases. Macrocommands are provided to form a large-scale compound program with component programs semiautomatically. A frame structure is introduced to categorize the I/O arguments of each engineering program and arrange them in a domain-specific hierarchical database. The system is flexible and evolutionary. Programs and data can be registered, maintained, and developed with little labor, thereby providing a systematic framework for constructing and developing hierarchical databases of programs and data. Author

N92-15621# National Lab. for High Energy Physics, Tsukuba (Japan).

A NEW PROGRAMMING METHOD FOR MULTI-TASK MULTI-COMPUTER SYSTEM WITH LOCAL AREA NETWORK: OBJP

HIDETOSHI NAKAGAWA Feb. 1991 81 p In JAPANESE; ENGLISH summary (DE91-508201; KEK-90-20) Avail: CASI HC A05/MF A01

At the KEK 12 GeV Proton Synchrotron (12GeV PS), the control computer system has been changed from the MELCOM-70 mini-computer system to VME-computer system, in which computers are connected with a local area network (LAN) called MAP (Manufacturing Automation Protocol). Before the replacement, a test control system with VME-computers was installed in the part of the control system. At the same time, a programming support environment called OBJP was implemented. The OBJP helps programmers to make real-time multi-computer application software. The OBJP is a PASCAL pre-processor, and it generates a PASCAL program from an OBJP source program. In the case of a small program like the sample in this paper, the ratio of program size (OBJP source / PASCAL source) is about 1 / 10. In this case, the OBJP source can be much simpler than the PASCAL source. Part 1 shows the idea of the OBJP. Part 2 shows how a PASCAL source is generated from an OBJP source. In part 3, the summary of the OBJP syntax is shown. DOE

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CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

A92-10483 QUADRATIC GAMES AND H(INFINITY)-TYPE PROBLEMS FOR TIME VARYING SYSTEMS

AKIRA ICHIKAWA (Shizuoka University, Hamamatsu, Japan) International Journal of Control (ISSN 0020-7179), vol. 54, Nov. 1991, p. 1249-1271. refs
Copyright

H(infinity)-type control problems with state feedback are considered for time-varying systems. First, general quadratic differential games are studied and then the relationship between H(infinity) problems and differential games is clarified. A necessary and sufficient condition for the existence of a stabilizing controller, such that the norm of the operator from the disturbance to the output is less than a prescribed number, is given in terms of a Riccati equation. Earlier results on time-invariant systems are found to be special cases of the main results. The finite horizon problem is also studied. Author

A92-11321 CONTROL OF SPACE FREE-FLYING ROBOT

KAZUYA YOSHIDA and YOJI UMETANI (Tokyo Institute of Technology, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 97-102. refs
Copyright

Both theoretical and experimental studies on the control of a free-flying robot manipulator for space application are presented. The goal of the studies is to develop a new control method for target capturing in a space micro-gravity environment, considering the dynamical interaction between the manipulator operation and the base vehicle motion. In the theoretical study, a generalized Jacobian matrix (GJM) concept of motion control and a guaranteed workspace (GWS) for path planning are investigated. In the experimental study, a laboratory model of a robot satellite supported on air bearings is developed; the model comprises a base satellite and a two-link manipulator arm. An on-line control scheme with vision feedback is developed for experimenting with capture operations, on the basis of the GJM and GWS. The manipulator can properly chase and capture both a standing target and a moving target in spite of the complex satellite/manipulator dynamical interaction. I.E.

A92-11322

CONTROL OF SPACE MANIPULATOR FOR CAPTURING A TUMBLING OBJECT

ZHENG H. LUO and YOSHIYUKI SAKAWA (Osaka University, Toyonaka, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 103-108. refs
Copyright

A space robot is considered which consists of a satellite base and a manipulator mounted on the base. The mission of the robot is to capture a tumbling object in space, the motion of which is governed by Euler's equation, by controlling the manipulator joint angles. First, the equations of motion of the space robot are derived by using the conservation law of linear and angular moments. Then, a sensory feedback control law is proposed which guarantees that both the position and the orientation of the manipulator hand coincide asymptotically with those of the tumbling object. Some results of a computer simulation are also shown. I.E.

A92-11331

ON THE ROLE OF DISTURBANCE ESTIMATION IN H(INFINITY) CONTROL SYSTEMS

R. KAWATANI, T. FUJII, and H. KIMURA (Osaka University, Suita, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 200, 201. refs
Copyright

In this paper, based on the analysis of H(infinity) controllers, an interesting and crucial observation concerning the structure of H(infinity) control systems is obtained. Due to this observation, closed-loop H(infinity) control systems can be clearly described as a disturbance estimator which is used to diminish the effect of exogenous input on the output. A clear representation of the feedforward-feedback structure of the H(infinity) controller is established. I.E.

A92-11418

POLYGON INTERVAL ARITHMETIC AND DESIGN OF ROBUST CONTROL SYSTEMS

YUZO OHTA, LEI GONG, and HIROMASA HANEDA (Kobe University, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 1065-1067. refs
(Contract MOESC-6355031)
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Robust stability analysis and the robust controller design problem of multivariable control systems are considered. To represent and treat the uncertainty of frequency response of plants and controllers, a notion of polygon interval arithmetic (PIA) is introduced. By using PIA, the robust stability problem is solved more efficiently than the method based on the mapping theorem. Moreover, by using PIA, a robust sequential return difference (RSRD) method is proposed, which is an improved version of the traditional SRD method in the sense that it can treat uncertainty contained in both plants and controllers, and that it is possible to guarantee integrity if it is desired. I.E.

A92-11454

A DESIGN OF CONTINUOUS-TIME MODEL REFERENCE ADAPTIVE CONTROL BASED ON A FUNCTION ESTIMATION OF PERIODICALLY TIME VARYING LINEAR SYSTEM

SEIICHI SHIN (Tsukuba, University, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2157-2162. refs
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The author presents a design for stable continuous-time model reference adaptive control based on function estimation of periodically time-varying linear systems with known variation period and unknown system degree. This control system uses a

nonminimum representation of the controlled object, where the controlled object is combined with an observer, thus eliminating direct use of a state and a filter to compensate for the relative degree of the controlled object. The controlled object should be uniformly observable, that is, observable in a finite interval of time. The observer and the filter are realized by convolution integrals in a finite span of time. Integral kernel functions of the observer are periodically time-varying functions with the same variation period as that of the controlled object; the representation consists of convolution integrals similar to those used in the observer. The global stability of the proposed adaptive control system is analyzed and a simple numerical simulation is performed for verification of the viability of the proposed control system. I.E.

**A92-11455
NEW ROBUST ADAPTIVE CONTROL SYSTEM USING
MULTIPLE REGULARIZATION PARAMETERS**

H. OHMORI and A. SANO (Keio University, Yokohama, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 4. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2163-2169. refs
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The design of a discrete-time model reference robust adaptive control system for a plant in the presence of bounded disturbances is investigated. The system uses a robust adaptive algorithm with multiple regularization parameters. This algorithm belongs to the class of leaky integration methods; thus the designed regularization parameters correspond to sigma in the sigma-modification approach. It is shown how to determine these regularization parameters theoretically such that minimization of the parameter error is attained in the presence of the disturbances, and it is not necessary for the upper bound of the disturbances to be known a priori. Furthermore, persistent spanning is ensured, regardless of the size of the disturbance. I.E.

**A92-11509
SEARCH METHODS FOR A CONSTANT SCALING MATRIX
ATTAINING MINIMUM H(INFINITY) NORM**

MASAMI SAEKI (Tsukuba, University, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2636, 2637. refs
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The authors propose two iterative methods of searching for a constant diagonal matrix W greater than 0 for which the $H(\infty)$ norm of $W0.5G(s)W-0.5$ takes minimum value. One uses an M-matrix property on a frequency domain and the other a Riccati equation property in a state space. Numerical examples show that the convergence is stable and quick within a few iterations by the frequency domain approach, and that the convergence is within several iterations for an appropriately chosen step length by the state space approach. I.E.

**A92-11511
ROBUSTNESS OF P-TYPE LEARNING CONTROL WITH A
FORGETTING FACTOR FOR ROBOTIC MOTIONS**

S. ARIMOTO, T. NANIWA, and H. SUZUKI (Tokyo, University, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2640-2645. refs
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A class of simple learning control algorithms with a forgetting factor and a long-term memory and without use of the derivative of velocity signals is proposed for motion control of robot manipulators. The robustness of such learning laws with respect to initialization errors, fluctuations of the dynamics, and measurement noises is studied extensively. As a result the uniform boundedness of motion trajectories is proved based on the passivity analysis of robot dynamics. It is also proved that motion trajectories converge to a neighborhood of the desired one and eventually remain in it provided the content of the long-term memory is refreshed adequately after a sufficient number of trials. I.E.

A92-11512

**FUZZY LEARNING GRASPING FORCE CONTROLLER FOR
MANIPULATOR HAND**

YASUHIKO DOTE, AMIN SUYITNO, and MIGUEL STREFEZZA (Muroran Institute of Technology, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2646, 2647. refs
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A novel fuzzy set adaptive and learning control algorithm is developed. It is applied to grasping force control for a manipulator hand powered by a transistor PWM (pulse width modulated) converter-fed servomotor. This robust manipulator hand can grip every object stably which has different compliance. This controller is applicable to systems whose dynamics changes time-variantly. The novel learning algorithm implemented 'off-line' is derived on the basis of sliding mode control. It gives strong error convergence properties proved by using the Lyapunov stability theorem, since it does not contain integrators as conventional adaptive mechanisms do. I.E.

A92-11537

**EXPERIMENTS ON THE H(INFINITY) DISTURBANCE
ATTENUATION CONTROL OF A MAGNETIC SUSPENSION
SYSTEM**

MASAYUKI FUJITA, FUMIO MATSUMURA (Kanazawa University, Japan), and KENKO UCHIDA (Waseda University, Tokyo, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2773-2778. refs
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An $H(\infty)$ disturbance attenuation controller is experimentally demonstrated on a magnetic suspension system with a flexible beam. The apparatus utilized is a simplified model of magnetic bearings with an elastic rotor. A simple mathematical model of the apparatus is derived by taking all the disturbances into consideration. An $H(\infty)$ disturbance attenuation control problem where the augmented plant is constructed with a frequency weighting function is set up. An iterative computing environment, MATLAB, is then employed to calculate the central controller. Finally, the controller is implemented using a digital signal processor, muPD77230, with 12-b A/D and D/A converters. Experimental results show that the designed system is robustly stable against various parameter changes and uncertainties. I.E.

A92-11552

**A COMPLEX SYSTEM APPROACH TO ROOT-CLUSTERING IN
SEPARATE REGIONS**

MASANOBU KOGA and KATSUHISA FURUTA (Tokyo Institute of Technology, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 5. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 2912-2917. refs
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A novel method which assigns all the poles of a closed-loop system in two specified separate regions of the complex plane is presented. A complex system of degree n , which corresponds to a real system of degree $2n$ with no real-axis poles, is introduced, and the relation between the feedback-control law of the complex system and that of the real system is derived. In the proposed algorithm, the feedback-control law is determined by using a Riccati equation of the complex system, whose parameters, states, inputs, and outputs are all complex numbers, which corresponds to a real system. I.E.

A92-11579

**ADAPTATION AND LEARNING FOR ROBOTIC MANIPULATOR
BY NEURAL NETWORK**

T. FUKUDA, T. SHIBATA (Nagoya University, Japan), M. TOKITA, and T. MITSUOKA (National Kisarazu Technical College, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical

and Electronics Engineers, Inc., 1990, p. 3283-3288. refs
Copyright

Neural network applications for robotic motion control in which the controller is applicable to position and force control of robotic manipulators are addressed. The proposed neural servo controller is based on a neural network which consists of input/output layers and two hidden layers, and which has time delay elements in its first hidden layer. This neural network can learn the complex dynamics of the system in forward manner to cooperate with the feedback loop, depending on the unknown characteristics of objects to be handled. A variable learning method, fuzzy turbo, which is based on fuzzy set theory, is proposed. This method can avoid stagnation during the learning process and has insensitive characteristics at a stable extreme, so that the neural network can learn the dynamical system quickly. Simulations are carried out for the case of force control handling of unknown objects and trajectory control handling of unknown payloads of a two-dimensional robotic manipulator. The results show the adaptability and applicability of the proposed neural servo controller to the nonlinear and dynamical system and the ability of the proposed fuzzy turbo. I.E.

A92-11580

**LEARNING CONTROL FOR A CLOSED LOOP SYSTEM USING
FEEDBACK-ERROR-LEARNING**

HIROAKI GOMI and MITSUO KAWATO (ATR Auditory and Visual Perception Research Laboratories, Kyoto, Japan) IN: IEEE Conference on Decision and Control, 29th, Honolulu, HI, Dec. 5-7, 1990, Proceedings. Vol. 6. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 3289-3294. refs
Copyright

The authors propose a novel learning scheme using feedback-error-learning for a neural network model applied to adaptive nonlinear feedback control. After the neural network compensates perfectly or partially for the nonlinearity of the controlled object through learning, the response of the controlled object follows the desired set in the conventional feedback controller. This learning scheme does not require the knowledge of the nonlinearity of a controlled object in advance. Using the proposed approach, the actual responses after learning correspond to desired responses. When the desired response in Cartesian space is required, learning impedance control is derived. The convergence properties of the neural networks are provided by the averaged equation and Lyapunov method. Simulation results on this learning approach are presented. The proposed scheme can be used for many kinds of controlled objects, such as chemical plants, machines, and robots. I.E.

A92-14542

**OUTPUT REGULATION FOR MULTIPLE-FREQUENCY
DISTURBANCES IN AN ACTIVE DYNAMIC VIBRATION
ABSORBER SYSTEM**

TAKESHI MIZUNO and KENJI ARAKI (Saitama University, Japan) IN: Computers in engineering 1990; Proceedings of the ASME International Computers in Engineering Conference and Exposition, Boston, MA, Aug. 5-9, 1990. Vol. 2. New York, American Society of Mechanical Engineers, 1990, p. 167-172. refs
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The theory of output regulation with internal stability is applied in designing the control system of an active dynamic vibration absorber system. By using the obtained control method the vibration of primary mass can be removed completely at a number of specified frequencies and attenuated well at the other frequencies. The number of frequencies, at which the amplitude of the vibration for primary mass is to be zero, and the values of the frequencies can be set in a desirable way with appropriate control circuits. Several numerical simulations on transient responses and numerical studies on the frequency characteristics show that the proposed control method is effective in reducing the vibration of primary mass. Author

A92-18476

**ROBOT VISION USING A FEATURE SEARCH STRATEGY
GENERATED FROM A 3-D OBJECT MODEL**

YOSHINORI KUNO, YASUKAZU OKAMOTO, and SATOSHI OKADA (Toshiba Corp., Kawasaki, Japan) IEEE Transactions on Pattern Analysis and Machine Intelligence (ISSN 0162-8828), vol. 13, Oct. 1991, p. 1085-1097. Research supported by Agency of Industrial Science and Technology. refs
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A robot vision system that automatically generates an object recognition strategy from a 3-D model and recognizes the object using this strategy is presented. The appearance of an object from various viewpoints is described in terms of visible 2-D features such as parallel lines and ellipses. Features are then ranked according to the number of viewpoints from which they are visible. The rank and feature extraction cost of each feature are used to generate a treelike strategy graph. This graph gives an efficient feature search order when the viewpoint is unknown, starting with commonly occurring features and ending with features specific to a certain viewpoint. The system searches for features in the order indicated by the graph. After detection, the system compares a line representation generated from the 3-D model with the image features to localize the object. Perspective projection is used in the localization process to obtain the precise position and attitude of the object, whereas orthographic projection is used in the strategy generation process to allow symbolic manipulation. Experimental results verify the efficiency and robustness of the system. I.E.

A92-19014

**SMOOTH TRAJECTORY CONTROL OF ROBOTIC
MANIPULATORS BASED ON MINIMUM ACCELERATION
CRITERION**

HIROYUKI KANO and KUNIHARU TAKAYAMA (Fujitsu, Ltd., International Institute for Advanced Study of Social Information Science, Numazu, Japan) Advanced Robotics (ISSN 0169-1864), vol. 5, no. 2, 1991, p. 147-164. refs
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A method for optimal trajectory control of robotic manipulators is considered, in this paper. In particular, a control scheme is proposed such that, while the manipulator passes two or more prescribed points, the resulting trajectory of motion is smooth. Such a problem is formulated by employing a criterion of minimum-mean-square acceleration during the entire period of motion. Although the motion of robot manipulators is governed by a system of second-order differential equations which are highly nonlinear, it is shown that the control problem can be solved rigorously under such a criterion. The optimal control consists of nonlinear compensation terms and other linear feedback terms. The results of computer simulation studies for a two-link manipulator are also included. Author

A92-19140

IMAGE MOVEMENT DETECTION WITH RELIABILITY INDICES
NAOYA OHTA (NEC Corp., C & C Information Technology Research Laboratories, Kawasaki, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Oct. 1991, p. 3379-3388. refs
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The reliability of a movement detected by the block gradient method is discussed, and three reliability indices are proposed. One index indicates the support level for the assumption used in the block gradient method. Two other indices indicate the image pattern condition, or the aperture problem level. The detected movement accuracy is rather directly related to this condition. Attention is also given to a movement stabilization process which smooths a movement field in the image, using the detected movements and two of the three indices. O.G.

A92-22522

**APPLICATION OF THE H(INFINITY) CONTROL THEORY TO
THE WAVE-ABSORBING CONTROL**

HIRONORI FUJII, KOICHI MATSUDA, and TOSHIYUKI

OHTSUKA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 456, 1992, p. 28-34. In Japanese. refs

This paper presents an approach to designing a broadband compensator by applying the $H(\infty)$ control theory to the wave-absorbing control method. The present approach aims to minimize the effect of the incoming waves on the outgoing waves at the actuators in the sense of the $H(\infty)$ norm of a scattering matrix. An application example of the present approach is shown by designing a compensator for a cantilever beam which is controlled at the free end. The performance and features of the designed compensator are examined both in the frequency and time domains. Its robustness characteristics are also examined.

Author

A92-23036

H(INFINITY) CONTROL PROBLEM WITH J(OMEGA)-AXIS ZEROS

SHINJI HARA (Tokyo Institute of Technology, Japan), TOSHIHARU SUGIE (Kyoto University, Uji, Japan), and RYOU KONDO (Ibaraki University, Hitachi, Japan) Automatica (ISSN 0005-1098), vol. 28, Jan. 1992, p. 55-70. Research supported by Manufacturing Research Corporation of Ontario. refs

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The so-called one-block $H(\infty)$ control problem in the case where the plant has $j(\omega)$ -axis (including infinity) poles and zeros is discussed. First, a necessary and sufficient condition for the $H(\infty)$ model-matching problem is derived to have a solution in the transfer function setting. Second, a solvability condition is given which makes it possible to check the solvability by examining matrix norm conditions related to $j(\omega)$ -axis zeros and solving two generalized Riccati equations. Finally, the result is extended to the standard $H(\infty)$ problem.

Author

A92-23671

TARGET CAPTURE EXPERIMENT BY A SPACE FREE-FLYING ROBOT

KAZUYA YOSHIDA and YOJI UMETANI (Tokyo Institute of Technology, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 85-88. refs

This paper presents experimental study of the control of a free-flying robot manipulator for space application. The goal is to develop a control method for target capturing in space microgravity environment, considering the dynamical interaction between the manipulator arm and the base vehicle. The Generalized Jacobian Matrix (GJM) concept for motion control and the Guaranteed Workspace (GWS) for path planning, are discussed. A laboratory model of robot satellite supported on air bearings is developed, which comprises a base satellite and a two-link manipulator arm. An on-line control scheme with vision feedback is developed for experimenting capture operations, utilizing the GJM and GWS. The manipulator can properly chase and capture both a standing target and a moving target in spite of complex satellite/manipulator dynamical interaction.

Author

A92-23675

SELF-ORGANIZATION IN CELLULAR ROBOTIC SYSTEM (CEBOT) FOR SPACE APPLICATION WITH KNOWLEDGE ALLOCATION METHOD

TOSHIO FUKUDA, TSUYOSHI UYEYAMA (Nagoya University, Japan), and YOSHIO KAWAUCHI (Tokyo, Science University, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 101-104. refs

A hardware is developed for a cellular robotic system (CEBOT) which is designed for the application to a space robot, and automatic docking between cells is realized by using air thrusters. As an analysis of CEBOT software, matrices are proposed; a knowledge-based structure matrix and task matrix are shown which can describe various states of the cell connection and knowledge

allocation. By using these proposed matrices, the automatic knowledge allocation is performed effectively and the simulation results are also dealt with.

Author

A92-23686

MODULAR NEURAL NETWORKS FOR MOTION CONTROL OF THE TRUSS-TYPE REDUNDANT ROBOT ARM

KAZUYUKI HANAHARA, MASAO TANAKA, and YASUYUKI SEGUCHI (Osaka University, Toyonaka, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 153-156. refs

In order to utilize kinematical redundancy effectively, this study proposes a neural-network approach for the criteria-oriented motion control of the truss-type redundant robot arm. A multilayered network and back propagation are the basic elements. The modular constitution is employed to build the resultant network for motion control, and it reduces the necessary transactions during the preparation stage of the network and the motion-control stage. This also enables flexible construction of the motion-control network in accordance with the various configurations of the arm system. A simulation study is carried out with the transputer-based multiprocessor system which demonstrates the feasibility of the proposed approach.

Author

A92-23688

A STUDY ON THE APPLICATION OF FUZZY SET THEORY TO STEREO VISION PROCESSING

MASAO NAKA, HIROMICHI YAMAMOTO, KOHZO HOMMA (National Aerospace Laboratory, Chofu, Japan), YASUSHI SUZUKI, and YOSHITAKA IWATA (Fujitsu FIP, Inc., Research and Development Center, Tokyo, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 161-164. refs

The purpose of the research is to develop and implement a high-level stereo vision-processing system which estimates 3D shapes and positions and recognizes space targets from stereo images acquired with passive optical image sensors (CCD TV cameras). Various effective image-enhancement and edge-perception methods are studied using the concept of fuzzy sets. Some comparative studies on image-enhancement and edge-detection methods in the fuzzy regions are performed through preliminary image-processing experiments.

Author

A92-23690

APPROACH IN CONSTRUCTION OF DIAGNOSTIC EXPERT SYSTEM FOR ENVIRONMENTAL CONTROL EQUIPMENT IN SPACE

NOBUYOSHI MUROI, YUICHI MIYAMOTO, and IKUO AKEYAMA (Kawasaki Heavy Industries, Ltd., Gifu, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 171-174. refs

The development of a fault-diagnosis expert system is described in terms of the component systems such as the inference engine and aerospace applications. The fault-diagnosis system is a knowledge-based system that employs functions of qualitative and continuous simulations and the inference engine to construct the suitable knowledge base. The concept is applied to the construction of a knowledge base for environmental control equipment. Rules for directed relationships between the functional blocks are generated automatically, interrelations between factors are extracted, and state changes are identified that can cause problems. A backtrack function is also incorporated which permits the system to trace the cause and effects of the problem phenomenon. The environmental control system shows the effectiveness of the general-purpose expert-systems building tool.

C.C.S.

A92-23708

FORCE CONTROL OF A SPACE MANIPULATOR

KATSUHIKO YAMADA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) and KAZUO TSUCHIYA (Osaka University, Suita, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 255-258. refs

Force control of a free-flying space robot is treated in this paper. As the satellite body of the space robot is not fixed in an inertia space, the force control law becomes different from that of a base-fixed robot. Considering quasi-static situation of the space robot and a target, two basic relations of the force control of the space robot are derived; one is the force control without any control of the satellite body, and the other one is the force control with the control of the satellite body. The force control laws based on the relations are examined by a numerical simulation. The simulation result shows that the force control without the satellite control becomes ineffective in a short time due to the motion of the space robot and the target. The result also shows that the satellite control by thrusters is effective to maintain the force control of the space robot. Author

A92-23712

FUZZY CONTROL METHOD FOR A SPACE MANIPULATOR SYSTEM

NAOKI IMASAKI, MASAOKI SONE, YASUO SHINOMIYA, and SHIN'ICHIRO NISHIDA (Toshiba Corp., Kawasaki, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 271-274. refs

For a long manipulator, such as in a Space Station, precise positioning performance is required. A flexible and robust control method is required, otherwise a backlash in the arm joint mechanism might cause positioning errors. The fuzzy temporal control method can be applied to the controller for such a manipulator. This paper reports results obtained from examination of fuzzy control rules containing ambiguous temporal information, and shows computer simulation results for a simple manipulator model. Author

A92-23713

POSITIONING CONTROL OF SPACE ROBOT WITH FLEXIBLE MANIPULATOR

YOSHISADA MUROTSU, SHOZO TSUJIO, KEI SENDA, and MASATO HAYASHI (Osaka Prefecture University, Sakai, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 275-278. refs

This paper is concerned with a formulation for a dynamical model of space robots with flexible manipulators and a control scheme to regulate the robot systems. Advanced space robots consist of a satellite base to fly freely and manipulators with structural flexibility caused by requirement of a light weight system. To control the complicated systems, a mathematical model of a space robot with structurally flexible manipulators is developed. An extended local PD-control scheme to control the flexible manipulators on a satellite base is proposed. The presented scheme is very simple and the stability of the closed loop system is proved by Liapunov's direct method. The effectiveness of the control scheme is also verified by numerical simulation. Author

A92-23716

ON THE MANIPULATION CONTROL OF SPACE ROBOT

NOBUYUKI KUBOTA, KIYOSHI IOI, TAKASHI KATSURAGAWA, OSAMU NORO, NOBUYOSHI MUROI, KENJI OGIMOTO, and OSAMU MIKI (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 287-290.

Experimental investigations are described in which 'hybrid impedance control' is employed to design the control criteria for manipulating a space robot. The performance of impedance control is examined in terms of the dynamic simulation analyses conducted for several maneuvers and operations. The response characteristics and actuator-torque requirements are defined for hybrid impedance control, and the simulation techniques are outlined. The sufficient conditions are given for catching a flying object, and illustrations are given of the incorporation of impedance control in and orbital replacement unit (ORU) insertion. ORU change-out is discussed as a candidate task for impedance control in the context of a task analysis that defines the components of the robot actions. The utility of computer simulations is noted for the development of the robotic requirements and supplementary sensors. C.C.S.

A92-23720

EFFICIENT COMPUTATIONAL ALGORITHMS FOR TRAJECTORY CONTROL OF MULTI-ARM SPACE MANIPULATORS

T. YOSHIKAWA, Y. YOKOKOHJI, and T. TOYOSHIMA (Kyoto University, Uji, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 303-306. refs

The generalized Jacobian matrix is employed as an effective algorithm for the case of multiple-arm space manipulators by two composite-link subsystems. The generalized Jacobian matrix is derived analytically for manipulators with n arms, and the two composite links are treated as a one-DOF system with only one reference joint. Based on this treatment an algorithm is developed for resolved acceleration control of multiple-arm space manipulators, and it is found that the computational amount is of the order $O(n)$ as it is in the single-arm space manipulators. The resolved-acceleration control algorithm is derived by incorporating the Newton-Euler method to determine the joint driving force. The result is an extension of the work by Yamada (1989) and presents a case for the development of multiple-arm space manipulators. C.C.S.

A92-25644

NOVELTY IMAGING SYSTEM WITH A DESIRED LONG-TIME SCALE USING BaTiO₃ AND A CONTROLLED SHUTTER SEQUENCE

TAKAMASA SUZUKI (Niigata University, Japan) and TAKUSO SATO (Tokyo Institute of Technology, Yokohama, Japan) Applied Optics (ISSN 0003-6935), vol. 31, Feb. 10, 1992, p. 606-612. refs

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A novelty imaging system using photorefractive crystal BaTiO₃ and a controlled shutter sequence, which can be applied to the slow-motion detection of the object, is proposed. In this system the observation time scale is set to the desired long value uninfluenced by the time constant of the crystal that is used. This system utilizes a photorefractive beam-fanning effect in the BaTiO₃ crystal, so it is constructed simply by using only the object beam without suffering from the external disturbance that is intrinsic when the reference beam is used. Moreover, the visibility for an opaque object is also maintained by the use of an additional random-phase plate. Author

A92-27393

POSITIONING CONTROL FOR A SPACE MANIPULATOR SYSTEM USING FUZZY CONTROL METHOD

NAOKI IMASAKI and SHIN'ICHIRO NISHIDA (Toshiba Corp., Kawasaki, Japan) (International Fuzzy Systems Association, World Congress, 4th, Brussels, Belgium, July 7-12, 1991) Toshiba's Selected Papers on Science and Technology (ISSN 0916-1465), vol. 4, no. 1, 1992, p. 13-16. refs

Copyright

For a space manipulator system with long links, it is difficult to achieve the precise positioning, because small amounts of backlash in the arm joint mechanisms might cause large positioning errors at the end effector. A flexible and robust controller is required to

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overcome the effects of backlash. A control method using fuzzy reasoning units can be applied to such a long-linkage manipulator system. Fuzzy temporal reasoning is also useful for smoothing changes in actuator force. This paper proposes a fuzzy control system which consists of fuzzy reasoning units, and presents a computer simulation with results for a simple manipulator model.

Author

A92-27672

ADAPTIVE STRUCTURES RESEARCH AT ISAS - 1984-1990

KORYO MIURA (Institute of Space and Astronautical Science, Sagami-hara, Japan) *Journal of Intelligent Material Systems and Structures* (ISSN 1045-389X), vol. 3, Jan. 1992, p. 54-74. refs
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This article reviews the research and development on adaptive structures and intelligent structural systems done by the structures and structural dynamic group at the Institute of Space and Astronautical Science (ISAS) from 1984 to 1990. Activity is closely linked to the practical needs for actively controlled structures on board scientific satellites and interplanetary vehicles which ISAS launches annually. The subjects described are: the proposal of novel structural concepts such as the variable geometry truss, the adaptive structure and the tension truss antenna; the proposal of vibration control schemes for flexible structures and the shape control scheme for precision antenna reflectors; and the study on construction of large space structures by assembling adaptive structures.

Author

A92-29068

CONSTRAINED OPTIMIZATION IN BANACH SPACE AND A GENERALIZED DUAL QUASI-NEWTON ALGORITHM FOR STATE-CONSTRAINED OPTIMAL CONTROL PROBLEMS

KIYOTAKA SHIMIZU and SATOSHI ITO (Keio University, Yokohama, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 1. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 364-369. refs
Copyright

A92-29074

AN ADJUSTABLE IMPEDANCE CONTROL ON THE NEURO-MUSCULAR SYSTEM

ATSUO KATO (Aichi Institute of Technology, Toyota, Japan), KUNIHICO ITO (Institute of Development Research, Kasugai, Japan), and MASAMI ITO (Nagoya University, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 1. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 403-408. refs
Copyright

The importance of an adjustable impedance control for contact task robots is described from the vantage point of the human arm control. To estimate the muscle viscous friction and elasticity change in contact task, visual target tracking experiments on the human wrist joint with an elastic load in continuous motion were conducted. Computer simulations were carried out on a dynamic model of the neuromuscular system. Because of correspondence of the experiments with the simulations it is possible to say that the compliant and stable robot performing contact tasks is best controlled by adjusting its joint damping and stiffness directly.

I.E.

A92-29136

A NECESSARY AND SUFFICIENT CONDITION FOR QUADRATIC STABILITY OF A MATRIX POLYTOPE

HIDEKI KOKAME (Osaka Institute of Technology, Japan) and TAKEHIRO MORI (Kyoto Institute of Technology, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 1. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 877, 878. refs
Copyright

A necessary and sufficient condition for the quadratic stability of uncertain linear systems is presented with the use of the class of symmetric matrices. Under a weak condition, a solution within

the class of symmetric matrices is proved to be positive-definite. Thus, without adding any complexity, one can deal with the stability problem in the class of symmetric matrices. It is emphasized that an advantage with this extension is gained when formulating the stability problem in the form of an optimization problem. Similar results for the discrete-time systems can be obtained easily. I.E.

A92-29145

A THEORY ON STRUCTURES OF AUTONOMOUS DISTRIBUTED SYSTEMS

HIDEO YUASA and MASAMI ITO (Nagoya University, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 1. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 930, 931. refs
Copyright

Phase differences are chosen as variables of a global pattern generator system, and a necessary and sufficient condition for local oscillator dynamics to make the relative phase system a gradient one is shown. This theorem makes clear the relation between local dynamics and global order. I.E.

A92-29178

DISCRETE-TIME H₂/H-INFINITY ROBUST CONTROL WITH STATE FEEDBACK

R. T. BAMBANG, E. SHIMEMURA, and K. UCHIDA (Waseda University, Tokyo, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 2. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 1172a, 1172b, 1173. refs
Copyright

A problem of designing robust control with mixed H₂/H-infinity performance objectives is considered for uncertain discrete-time systems, under the assumption that the state is available for feedback. The controller derived is guaranteed to satisfy a prespecified H-infinity disturbance attenuation constraint for plant perturbations within a specified class of uncertainties while providing bounds on worst-case quadratic performance. I.E.

A92-29336

ROBUST HOLDING CONTROL OF TWO COOPERATING ROBOT MANIPULATORS

MASARU UCHIYAMA and TOSHIKI YAMASHITA (Tohoku University, Sendai, Japan) IN: 1991 American Control Conference, 10th, Boston, MA, June 26-28, 1991, Proceedings. Vol. 3. Piscataway, NJ, Institute of Electrical and Electronics Engineers, 1991, p. 2521-2526. refs
(Contract MOESC-63550178)
Copyright

The adaptive load sharing needed for two cooperating manipulators to hold a common object robustly is dealt with. The task vectors for describing the task are summarized, and a hybrid control scheme for the simultaneous control of the holding forces and the carrying positions is presented. Within this framework, the robust holding problem is analyzed, paying attention to the contact conditions between the manipulators and the object. The contact conditions are formulated as a set of linear inequalities with respect to the load sharing coefficients. Based on the analysis, a heuristic but very simple algorithm for the online adaptation of the load sharing coefficients for robust holding is presented. I.E.

A92-29519

A FEATURE OF THE MISSION-FUNCTION CONTROL

HIRONORI FUJII (Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 40, no. 457, 1992, p. 103-110. In Japanese. refs

A feature of the mission-function (MF) control is studied. The MF control is a control algorithm compatible with the fundamentals of mechanics of flexible structures and employs the mission function. The mission function is a Liapunov function which includes such mechanical information of the system as the Hamiltonian and also a generalized energy to improve the performance of the controller. This paper presents the necessary conditions for the MF control in a general form. Another purpose of the paper is to

present a feature belonging to the MF control, namely, that application of the control algorithm reduces to the design of an optimal regulator for the flexible structural system. Two examples for application of the MF control are shown through the use of the numerical simulation. Author

A92-29707

COORDINATED MOTION CONTROL OF ROBOT ARMS BASED ON THE VIRTUAL INTERNAL MODEL

MASANOBU KOGA (Tokyo Institute of Technology, Japan), KAZUHIRO KOSUGE (Nagoya University, Japan), KATSUHIKA FURUTA (Tokyo Institute of Technology, Japan), and KAGEHARU NOSAKI (Sony Corp., Components Development Group, Tokyo, Japan) IEEE Transactions on Robotics and Automation (ISSN 1042-296X), vol. 8, Feb. 1992, p. 77-85. refs

Copyright

An alternative coordinated motion control architecture for robot arms manipulating an object is proposed. The motion and the internal force of the object are resolved into the motion of each arm. Each arm is controlled based on the virtual internal model so as to operate in coordination even if geometric errors exist in the robot arms and the object. The virtual internal model is a reference model driven by sensory information implemented in the controller. The proposed architecture will keep the state of the system bounded even if the breakage of the manipulated object occurs. The control algorithm is experimentally applied to the coordinated motion control of two planar robot arms, each of which has three degrees of freedom. The results illustrate the validity of the proposed control architecture. I.E.

A92-30060

NEURAL NETWORK PRUNING BY FUSING HIDDEN LAYER UNITS

KEISUKE KAMEYAMA and YUKIO KOSUGI (Tokyo Institute of Technology, Yokohama, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Dec. 1991, p. 4198-4204. refs

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Neural network pruning is a technique to obtain a fully functional subset of a redundant network for the efficiency of computation. A new method to prune a redundant three-layered neural network by means of neural element 'fusion' is introduced. In contrast to conventional pruning techniques that remove unimportant portions of the network, this method fuses a pair of hidden layer units so that features accumulated in both units are preserved as possible. The pair of hidden layer units to be fused is chosen by evaluating a firing similarity. This similarity measure also informs when the pruning should be stopped. The fusing method was compared with well-known 'unit removing' methods on computer simulations. The results show that the fusing method considerably reduces the error increase due to the pruning, even in subminimal networks where conventional methods are ineffective. This enables reduction of the total cost of computation to reach the minimal network configuration. Author

A92-30994

INTELLIGENT AND COOPERATIVE CONTROL OF TELEROBOT TASKS

SHIGEOKI HIRAI, TOMOMASA SATO, and TOSHIHIRO MATSUI (Electrotechnical Laboratory, Tsukuba, Japan) (IEEE, Conference on Decision and Control, Honolulu, HI, Dec. 5-7, 1990) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 12, Feb. 1992, p. 51-56. refs

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Techniques of intelligent and cooperative control of a telerobot have been implemented in a telerobot system called MEISTER (Model Enhanced Intelligent and Skillful Teleoperational Robot), which integrates a task knowledge base and cooperative control to realize man/robot cooperation in task execution from the intelligent level to the motion level. To support multilevel man/robot cooperation, MEISTER is equipped with a motion understanding system that maintains the world model even when the human operator executes tasks through direct maneuvering of the robot.

The system is described, and a flame test chemical experiment showing how the proposed techniques for man/robot cooperation work in a telerobot task is reported. I.E.

A92-31038

OMNI-DIRECTIONAL STEREO

HIROSHI ISHIGURO, MASASHI YAMAMOTO, and SABURO TSUJI (Osaka University, Japan) IEEE Transactions on Pattern Analysis and Machine Intelligence (ISSN 0162-8828), vol. 14, Feb. 1992, p. 257-262. Research supported by MOESC. refs

Copyright

Omnidirectional views of an indoor environment at different locations are integrated into a global map. A single camera swiveling about the vertical axis takes consecutive images and arranges them into a panoramic representation, which provides rich information around the observation point: a precise omnidirectional view of the environment and coarse ranges to objects in it. Using the coarse map, the system autonomously plans consecutive observations at the intersections of lines connecting object points, where the directions of the imaging are estimated easily and precisely. From two panoramic views at the two planned locations, a modified binocular stereo method yields a more precise, but with direction-dependent uncertainties, local map. New observation points are selected to decrease the uncertainty, and another local map is yielded, which is then integrated into a more reliable global representation of the world with the adjacent local maps. I.E.

A92-31040* National Aeronautics and Space Administration, Washington, DC.

HIGH-RESOLUTION TERRAIN MAP FROM MULTIPLE SENSOR DATA

IN S. KWEON (Toshiba Corp., Research and Development Center, Kawasaki, Japan) and TAKEO KANADE (Carnegie Mellon University, Pittsburgh, PA) IEEE Transactions on Pattern Analysis and Machine Intelligence (ISSN 0162-8828), vol. 14, Feb. 1992, p. 278-292. refs

(Contract NAGW-1175)

Copyright

The authors present 3-D vision techniques for incrementally building an accurate 3-D representation of rugged terrain using multiple sensors. They have developed the locus method to model the rugged terrain. The locus method exploits sensor geometry to efficiently build a terrain representation from multiple sensor data. The locus method is used to estimate the vehicle position in the digital elevation map (DEM) by matching a sequence of range images with the DEM. Experimental results from large-scale real and synthetic terrains demonstrate the feasibility and power of the 3-D mapping techniques for rugged terrain. In real world experiments, a composite terrain map was built by merging 125 real range images. Using synthetic range images, a composite map of 150 m was produced from 159 images. With the proposed system, mobile robots operating in rugged environments can build accurate terrain models from multiple sensor data. I.E.

A92-31573

MULTIVARIABLE ROOT LOCI OF CONTROL SYSTEMS OF ROBOT MANIPULATORS WITH FLEXIBLE DRIVING SYSTEMS (DISTORTION FEEDBACK)

JUNJI FURUSHO (University of Electro-Communications, Chofu, Japan), HIROSHI NAGAO (Mizuno Corp., Product Development Div., Osaka, Japan), and MAKOTO NARUSE (Gifu University, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, March 1992, p. 65-73. refs

Copyright

Two characterizations of the behavior of closed-loop eigenvalues for cases where high-gain distortion feedback is present are given, with a view to the prevention of robot-arm vibration due to drive-system flexibility. The high-gain feedback of distortion in driving systems at robot joints can improve oscillatory behavior. The feedback of twisting angles was found to move eigenvalues leftward in the complex plane, and in addition improved the time response. O.C.

A92-31574

CONFIGURATION CONTROL OF THE TRUSS-TYPE PARALLEL MANIPULATOR BY THE MODULAR NEURAL NETWORK MODEL

MASAO TANAKA, KAZUYUKI HANAHARA, and YASUYUKI SEGUCHI (Osaka University, Toyonaka, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, March 1992, p. 89-95. Research supported by MOESC. refs Copyright

A new control method for the truss-type parallel manipulator is proposed by a neural network approach. The proposed method solves the inverse kinematic problem involving kinematic redundancy with the multilayered neural network model. This neural network model is prepared to provide the kinematic relation of the manipulator as well as the criterion function for the configuration and/or motion control. A concept of the modular neural network is employed to cope with the immensity of the network, in which a neural network module is constructed separately for each kinematic module. This modular neural network approach enables the network system for the configuration control to be adopted for various combinations of truss modules. Some simulation studies demonstrate the effectiveness and the potential capability of the proposed method. Author

A92-31575

CONTROL OF MOBILE LINKED FLEXIBLE SYSTEM

TOSHIO FUKUDA (Nagoya University, Japan), HIDEMI HOSOKAI, and AKIHIKO HIROTSU (Tokyo, Science University, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, March 1992, p. 96-101. refs Copyright

Mobile control and vibration-damping methods are proposed for large space structures derived from the linking of flexible substructures; the control/damping system employs compressed-air jet nozzles at each of the structure's floating pads, as well as a dc motor at the linkage joint between adjacent structural elements. The system is modeled by a lumped-parameter system; the control method is applied to the present simulation in such a way that the flexible structure is entirely floated by the air-jet bearings at the joints, and reaction forces from the ground to the floating system are precluded. O.C.

A92-32373

A NEURAL NETWORK MODEL FOR FINDING A NEAR-MAXIMUM CLIQUE

NUBUO FUNABIKI (Sumitomo Metal Industries, Ltd., Japan), YOSHIYASU TAKEFUJI (Case Western Reserve University, Cleveland, OH), and KUO-CHUN LEE (Cirrus Logic, Inc., Fremont, CA) Journal of Parallel and Distributed Computing (ISSN 0743-7315), vol. 14, March 1992, p. 340-344. refs Copyright

A neural network-based parallel algorithm is presently used to ascertain a near-maximum clique, where the maximum clique is understood to be a maximum complete subgraph of a graph G on which any two vertices are adjacent, and the maximum clique-finding problem is NP-complete. The algorithm is tested through the solution of 230 graph problems, which indicate that solution qualities comparable to those of two better-known algorithms on a Cray 2 and an IBM 3090 are obtainable with shorter computation times on a Macintosh IIx. O.C.

A92-33612

SELF-ORGANIZING VISUAL SERVO SYSTEM BASED ON NEURAL NETWORKS

HIDEKI HASHIMOTO, TAKASHI KUBOTA (Tokyo, University, Japan), MASAOKI KUDOU (Hitachi, Ltd., Japan), and FUMIO HARASHIMA (Tokyo, University, Japan) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 12, April 1992, p. 31-36. refs Copyright

A neural-network-based self-organizing control system for a robotic manipulator is presented. The end-effector position and orientation control loop is closed using visual data to generate the necessary control inputs for the manipulator joints by two

neural networks. The task considered is to move the manipulator end-effector to a position where an object can easily be gripped. The relations between image data of the object and joint angles of the desired manipulator end-effector position and orientation are clearly nonlinear. The system organizes itself for any manipulator configuration by learning this nonlinear mapping regardless of joint type and geometric dimensions, so that the inverse kinematic solution need not be calculated. A global network learns control signals for larger object distances, and a local network for smaller ones. The generalization ability of the neural networks assures control robustness and adaptability in cases of slightly changed object positions. I.E.

A92-35633

DEEP SPACE ORBITAL CONTROL USING NEURAL NETWORKS

T. HIROSAKI, R. IBE, and YUZO SHIMADA (Nihon University, Funabashi, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 67, 68. In Japanese.

A learning model of neural networks for spacecraft guidance, navigation, and control is presented. Factors affecting the accuracy of the orbital control are discussed. A simulation for the orbital calculation is presented. Y.P.Q.

A92-37324

MODAL PARAMETER IDENTIFICATION FOR VIBRATION CONTROL

NORIHIRO GOTO (Kyushu University, Fukuoka, Japan), SHINJI HOKAMOTO (Saga University, Japan), TAKANORI TASHIMA (Mitsubishi Electric Corp., Kamakura Works, Japan), and YOSHIRO OKA (Mitsubishi Motors Corp., Tokyo, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 51, no. 4, Dec. 1991, p. 179-193. refs

For the active control of flexural vibrations the parameters in the mathematical model of a vibrating structure must be determined. A stochastic modeling method is applied to the identification of modal parameters including undamped natural frequencies and damping ratios. Autoregressive and autoregressive-moving average models are used and compared to extract significant features of the method. A simulation study using multidegree of freedom vibration systems shows that the accuracy of estimation depends on data-length, sampling interval and measurement noise. An application of the method to the experimental data of the transverse vibration of a cantilever beam demonstrates that the identified results of the natural frequencies are quite consistent and those of the damping ratios are reasonable to the first digit. The results are compared with those obtained by other methods to discuss the practicality and reliability of the proposed method. Author

A92-37975

PATTERN FORMATION OF SYNAPTIC CONNECTION IN A GENERALIZED HEBB-TYPE LEARNING MODEL

YOSHIYUKI USAMI (Kanagawa University, Yokohama, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 735-743. refs Copyright

The similarity between the learning process of a neural network and its pattern formation is analyzed by introducing a potential function of synaptic-connection weight into the Hebb-type learning equation. The equation assumes that the synapse connection weight has force term describing an arbitrary potential function that can have double stable points. The learning model is utilized in a computer simulation which demonstrates that the system can maintain learned patterns when the patterns are no longer being presented. The model is found to reflect the observation of a critical period in the brain's nerve system. The simulation of this property suggests that the synaptic behavior of pattern formation in the present learning model represents a neural logic similar to that of the human brain. C.C.S.

A92-39262

ADAPTIVE REJECTION OF UNKNOWN DISTURBANCES IN SERVOMECHANISMS

ZHAO-WEI ZHONG (Institute of Physical and Chemical Research, Wako, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 349-369. Research supported by Institute of Physical and Chemical Research. refs Copyright

The fact that the influence of disturbances on a learning control system having a basic system and a typical iterative learning compensator is larger than that on the same basic system without the learning compensator is discussed. The problem is addressed using an iterative learning compensator, which is applied to practical servomechanisms. The results show that it is practical and useful to apply this learning control without deteriorating the practical servomechanisms. A second method for rejecting unknown period disturbance which cannot be directly observed is disposed. This method can effectively reject the designated components of the disturbance without having an effect on the other components. It does not negatively affect the system. This method is simple and effective only when the disturbance is periodic and its phase is constant. It can be used to reject a period disturbance having an unknown phase shift, and a disturbance whose shape is unchanged but whose amplitude is a function of time, when it is adopted together with other methods. P.D.

A92-39264

CRITERIA-ORIENTED CONFIGURATION CONTROL OF ADAPTIVE STRUCTURE AND ITS MODULAR NEURAL NETWORK REPRESENTATION

YASUYUKI SEGUCHI, MASAO TANAKA, and KAZUYUKI HANAHARA (Osaka University, Toyonaka, Japan) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 402-421. refs Copyright

The adaptive truss structure has the capability to perform specified tasks smartly and/or to meet the environment by changing its geometrical and mechanical properties actively. It is a kinematically redundant system in nature and the criteria-oriented approach is the conventional in order to resolve the redundancy. This article discusses a new neural network approach to this criteria-oriented configuration control. The basic idea is proposed based on the multi-layered neural network and the error back-propagation scheme. Then, the modular neural network representation is discussed to reduce the learning transaction in practical level, since the scale of the total neural network becomes very large due to the hugeness and the complexity of the problem. Simulations studies are carried out based on a transputer-based multi-processor system and the feasibility is examined. Author

A92-40348

FUNCTIONAL ABILITIES OF A STOCHASTIC LOGIC NEURAL NETWORK

YOSHIKAZU KONDO and YASUJI SAWADA (Tohoku University, Sendai, Japan) IEEE Transactions on Neural Networks (ISSN 1045-9227), vol. 3, no. 3, May 1992, p. 434-443. refs Copyright

A study is presented on the information processing ability of stochastic logic neural networks, which constitute one of the pulse-coded artificial neural network families. The effects of the coding noise and the limited range of the synaptic weights on association ability are studied. It is found analytically that the limited range of the synaptic weights reduces the coding noise and suppresses the degradation of memory storage capacity. In order to study the effect of the coding noise on an optimization problem, a probabilistic Hopfield model (Gaussian machine) is simulated which has a continuous neuron output function and probabilistic behavior. A proper choice of the coding noise amplitude and scheduling improves the network's solutions of the traveling salesman problem. The results suggest that stochastic logic may

be useful for implementing probabilistic dynamics as well as deterministic dynamics. S.A.V.

A92-40356

ALGEBRAIC DESCRIPTION OF CURVE STRUCTURE

HIROBUMI NISHIDA and SHUNJI MORI (Ricoh Co., Ltd., Research and Development Center, Yokohama, Japan) IEEE Transactions on Pattern Analysis and Machine Intelligence (ISSN 0162-8828), vol. 14, no. 5, May 1992, p. 516-533. refs Copyright

A compact and concise description method for curves in terms of the quasi-topological features and the structure of each singular point is proposed. By quasi-topological features are meant the convexity, loop, and connectivity. The quasi-topological structure is analyzed in a hierarchical way, and algebraic structure is presented explicitly on each representation level. The lower level representations are integrated into the higher-level one in a systematic way. When a curve has singular points (branch points), the curve is decomposed into components, where each is a simple arc or a simple closed curve by decomposing each singular point. The description scheme is applied to character recognition. Author

A92-40372

AN ULTRASONIC VISUAL SENSOR FOR THREE-DIMENSIONAL OBJECT RECOGNITION USING NEURAL NETWORKS

SUMIO WATANABE and MASAHIDE YONEYAMA (Ricoh Co., Ltd., Research and Development Center, Yokohama, Japan) IEEE Transactions on Robotics and Automation (ISSN 1042-296X), vol. 8, no. 2, April 1992, p. 240-249. refs Copyright

A 3D object recognition system is proposed which improves acoustic imaging by combining holography with a time flight range method. The system also improves neural networks for 3D image processing. The system can identify object categories regardless of their locations, estimate x,y coordinates of their centers, and improve the quality of the image even when multiple objects are placed within the field of vision. The practicability of the system is indicated by experimental results obtained using only a small number of transducers. C.D.

A92-41832

A NEW CONTROL TECHNIQUE BASED ON THE LAC/HAC CONCEPT FOR FLEXIBLE STRUCTURES

SHINJI HOKAMOTO (Saga University, Japan) and NORIHIRO GOTO (Kyushu University, Fukuoka, Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, no. 106, Feb. 1992, p. 240-249. refs

A new control technique based on the LAC/HAC concept is proposed to suppress the vibration of flexible space structures. The new technique employs the mechanism to turn on or off the HAC part of the LAC/HAC system in such a manner as to suppress the spillover effects as quickly as possible. The control system designed by the new technique has global stability and is more effective than a pure LAC system, even when an ordinary LAC/HAC system results in failure because of spillover instability. To show the characteristic features of the new technique and how to implement the system, computer simulation examples are given. The technique is applied to the transversal vibration control of a cantilever beam to show its effectiveness and practicality. Author

A92-42183

IMAGE COMPRESSION USING A NEURAL NETWORK WITH LEARNING CAPABILITY OF VARIABLE FUNCTION OF A NEURAL UNIT

RYUJI KOHNO, MITSURU ARAI, and HIDEKI IMAI (Yokohama National University, Japan) IN: Visual communications and image processing '90; Proceedings of the Meeting, Lausanne, Switzerland, Oct. 1-4, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 69-75. refs Copyright

63 CYBERNETICS

This paper proposes image compression using an advanced neural network in which a variable input-output function of a neural unit can be learned as well as a weight coefficient of a neural connection corresponding to information source and application. Since the neural network has the improved learning capability for local nonlinearity of the information source, its application to the compression of nonlinear information such as image is investigated. A learning algorithm and adaptive controlling schemes of input-output functions are derived. Simulation results show that the neural network can achieve higher SNR and shorter learning time than a conventional network having only variable weights.

Author

A92-42216

SOURCE CODING OF SUPER HIGH DEFINITION IMAGES WITH DISCRETE COSINE TRANSFORM

MITSURU NOMURA, TETSUROU FUJII, and NAOHISA OHTA (NTT, Transmission Systems Laboratories, Yokosuka, Japan) IN: Visual communications and image processing '90; Proceedings of the Meeting, Lausanne, Switzerland, Oct. 1-4, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 814-825. refs

Copyright

This paper discusses the bit-rate compression of super high definition images with Discrete Cosine Transform (DCT). Super high definition images with more than 2048 x 2048 pixels of resolution are introduced as the next generation image category beyond HDTV. In order to develop bit-rate reduction algorithms, an image I/O system for super high definition still images is assembled. A traditional DCT based coding algorithm called Scene Adaptive Coder (SAC) is applied to super high definition images and related problems are clarified. A new coding algorithm is proposed, which takes human visual perception characteristics into consideration, and its coding performance is examined for super high definition images.

Author

A92-42587

INCOHERENT OPTICAL ASSOCIATIVE MEMORY BY USING SYNTHETIC DISCRIMINANT FUNCTION FILTERS

MASAKI TANIGUCHI (Osaka University, Suita, Japan), KATSUNORI MATSUOKA (Government Industrial Research Institute, Ikeda, Japan), and YOSHIKI ICHIOKA (Osaka University, Suita, Japan) Applied Optics (ISSN 0003-6935), vol. 31, no. 17, June 10, 1992, p. 3295-3301. Research supported by Osaka Science and Technology Center. refs

Copyright

A new cross-talk-free associative memory system with incoherent correlators is proposed. The system, which is based on a nonlinear processor and optical-electronic feedback loop, is capable of recalling memorized patterns without cross talk. The system electronically amplifies the intermediate signal, which results in a bright output pattern. A synthetic discriminant function used in the system to design a correlation filter makes it possible to achieve high association performance and stable operation.

O.G.

A92-43178

INSPECTION OF STABILITY DETERIORATION WITH AN ADAPTIVE REGULATOR

RYOJI KATAYANAGI (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 376-379. In Japanese.

An optimum regulator for the feedback control system of the aircraft is presented. The state equations are given and the performance of the closed loop system is discussed. The inspection of the stability deterioration is described.

Y.P.Q.

A92-43179

POWER FEEDBACK WITH ZERO POINT COLLOCATION OF AN ADAPTIVE REGULATOR

RYOJI KATAYANAGI (Mitsubishi Heavy Industries, Ltd., Tokyo,

Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 380-383. In Japanese.

Zero point collocation of an optimal regulator is presented. The state equations are given and the power feedback system is analyzed.

Y.P.Q.

A92-43181

FLIGHT CONTROL SYSTEM DESIGN

H. OTA (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 388-391. In Japanese.

A linear quadratic Gaussian (LQG) compensator synthesis approach is applied to flight control system design. The Kalman filter (KF) and linear quadratic regulator (LQR) are given for the control design. The open and closed loop poles are analyzed.

Y.P.Q.

A92-43187

NONSTATIONARY MANUAL CONTROL III

H. MATSUMOTO (Toshiba Corp., Tokyo, Japan) and N. GOTO (Kyushu University, Fukuoka, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 412-415. In Japanese. refs

Simulation of the nonstationary manual control of an aircraft is presented. Test methods and procedures are introduced. The pilot control data are recorded, and spectral analysis of the manual control system is illustrated.

Y.P.Q.

A92-43275

H(INFINITY) OPTIMIZED BROADBAND COMPENSATOR FOR WAVE-ABSORBING CONTROL

HIRONORI FUJII, KHOICHI MATSUDA, and TOSHIYUKI OHTSUKA (Tokyo Metropolitan Institute of Technology, Hino, Japan) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 1. San Diego, CA, Univelt, Inc., 1992, p. 379-394. Research supported by Special Research Fund of Tokyo Metropolitan Government. refs (AAS PAPER 91-377) Copyright

A sensitivity-reduction technique formulated as a model-matching problem is presented in which H(infinity) control theory is applied to the wave-absorbing control method. The H(infinity) norm of the closed-loop scattering matrix at actuator locations is minimized, and partial differential equations are used to treat incoming disturbance waves. The technique is demonstrated by designing a compensator for a cantilevered Bernoulli-Euler beam with a collocated force actuator and velocity sensor at the free end. The compensator is shown to provide a gain that is proportional to that of a compensator designed by minimizing the H(infinity) norm of the power flow into the structure. Deviations from the optimal value in the present approximation are examined, and numerical simulations demonstrate the effectiveness of broadband damping obtained with the compensator.

C.C.S.

A92-43376

SHAPING OF SYSTEM RESPONSES WITH MINIMAX OPTIMIZATION IN THE TIME DOMAIN

TOSHIYUKI OHTSUKA and HIRONORI FUJII (Tokyo Metropolitan Institute of Technology, Japan) IN: Astrodynamics 1991; Proceedings of the AAS/AIAA Astrodynamics Conference, Durango, CO, Aug. 19-22, 1991. Pt. 3. San Diego, CA, Univelt, Inc., 1992, p. 2145-2164. Research supported by the Special Research Fund of Tokyo Metropolitan Government. refs (AAS PAPER 91-531) Copyright

A minimax optimization problem is introduced for terminal control of generic dynamical system without disturbances. The maximum magnitude of weighted output of the system is minimized over a finite interval by the control input of a prescribed class. Such important characteristics of the controlled system appear explicitly in the proposed problem as the maximum magnitude and the

settling property of the output. The minimum principle results in a necessary condition for the optimal control input and a two-point boundary-value problem associated with the minimax optimization. A few numerical examples are shown to illustrate the problem.

Author

A92-44753

H(INFINITY)/LTR PROCEDURE WITH SPECIFIED DEGREE OF RECOVERY

MASAMI SAEKI (Tsukuba, University, Japan) Automatica (ISSN 0005-1098), vol. 28, no. 3, May 1992, p. 509-517. refs
Copyright

This paper presents a loop-transfer-recovery (LTR) procedure which recovers a robustness property at plants inputs to a specified degree. Stability of a controller is a necessary condition for the LTR procedure. A weighted difference between the open-loop transfer function of a state feedback system by a LQ regulator and that of an output feedback system by a LQ regulator with an observer is estimated quantitatively by an H(infinity) norm. A design problem of full/minimal order observers for which the norm is less than a specified value is proposed. This problem is reduced to an H(infinity) optimal control problem with state feedback.

Author

A92-45454

MANUAL CONTROL OF VEHICLES WITH TIME-VARYING DYNAMICS

NORIHITO GOTO (Kyushu University, Fukuoka, Japan) and HIROYUKI MATSUMOTO (Toshiba Co., Komukai Works, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 863-869. refs
(SAE PAPER 912078) Copyright

An experiment was conducted to seek the models of the human pilot controlling a vehicle with time-varying dynamics manually. In the experiment the human pilot controlled basic first-order linear time-varying controlled elements in a compensatory closed-loop fashion for step and random inputs. The analysis of the experimental data has found that for the step input case the human pilot can be modeled as a stationary proportional-plus-integral controller, whereas for the random input case a stationary model with constant coefficients cannot describe the pilot's control behavior sufficiently well. A nonstationary time series analysis suggests that the human pilot's control behavior for the random input case is also time-varying; adapting his characteristics to the changing controlled element dynamics in such a manner that the error and output spectral characteristics do not make appreciable changes with respect to time.

Author

A92-45456

A DESIGN OF STRONGLY STABILIZING CONTROLLER

MASAYUKI SUZUKI, SHOHEI NIWA, and SHIN OKAZAWA (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 883-889. refs
(SAE PAPER 912081) Copyright

A new convenient method for the design of strongly stabilizing controllers is presented. The method is derived by applying the quadratic stabilization method which is developed for the robust stabilization of uncertain systems. Some examples illustrating the design method's effectiveness are adduced.

C.A.B.

A92-46107

A DISCRETE-TIME DESIGN OF ROBUST ITERATIVE LEARNING CONTROLLERS

TADASHI ISHIIHARA (Tohoku University, Sendai, Japan), KENICHI ABE (Toyoashi University of Technology, Japan), and HIROSHI TAKEDA (Tohoku University, Sendai, Japan) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. 22, no. 1, Jan.-Feb. 1992, p. 74-84. refs
Copyright

A simple discrete-time design of robust iterative learning controllers, taking account of the transient behavior as well as the uncertainty of a plant, has been proposed. Using the impulse response sequence of a plant, a simple finite-dimensional formulation of the problem is given. Assuming that a nominal impulse response sequence is given, it is proposed that a design based on the minimization of a quadratic performance index be regarded as a measure for the transient performance. Then, the effect of the error in the impulse response data is analyzed. It is shown that an excessively high-order controller is not robust in the sense that the error severely deteriorates the transient performance. To obtain a robust controller with a reasonable order, a design based on a probabilistic modeling of the error in the impulse response data is proposed. The controller is obtained by minimizing an averaged quadratic performance index. Simulation examples are presented to illustrate the effectiveness of the proposed methods.

Author

A92-47589

POSITION AND FORCE CONTROL OF MANIPULATORS WITHOUT USING FORCE SENSORS

ZHI-XIN PENG and NORIHIKO ADACHI (Niigata University, Japan) JSME International Journal, Series III (ISSN 0914-8825), vol. 35, no. 2, June 1992, p. 252-258. refs
Copyright

In this paper, position and force control of constrained motion of robotic manipulators is discussed. First, issues related to decoupling position- and force-controlled directions are discussed. The fundamentals of estimation of contact forces without using force or torque sensors are then presented, and a control scheme for position and force control of robotic manipulators without force sensing is proposed. The extension of this scheme to redundant manipulators is also discussed. Finally, the proposed control scheme is implemented on a 3-DOF planar redundant manipulator, and some experimental results are presented to illustrate the validity of the control scheme.

Author

A92-48217

NEURAL NETWORK CONTROLLER USING AUTOTUNING METHOD FOR NONLINEAR FUNCTIONS

TAKAYUKI YAMADA and TETSURO YABUTA (NTT, Telecommunication Field Systems Research and Development Center, Tokai, Japan) IEEE Transactions on Neural Networks (ISSN 1045-9227), vol. 3, no. 4, July 1992, p. 595-601. refs
Copyright

Many studies, among them Kawato's work, have been undertaken in order to apply both the flexibility and the learning ability of neural networks to dynamic system controllers. However, many parameters, such as the optimum shape of the sigmoid functions (nonlinear saturated functions), are determined by trial and error. These parameters inhibit the advanced application of neural networks. Therefore, this paper proposes an autotuning method for the optimum sigmoid function of neural networks. Simulated results using a learning-type direct controller confirm both the practicality and the characteristics of the proposed autotuning method.

Author

A92-48641

ROBUST AND SIMPLE ADAPTIVE CONTROL SYSTEMS

Z. IWAI and I. MIZUMOTO (Kumamoto University, Japan) International Journal of Control (ISSN 0020-7179), vol. 55, no. 6, June 1992, p. 1453-1470. refs
Copyright

This paper deals with two problems for the improvement of the control performance of simple adaptive control (SAC) techniques. First, it is noted that the introduction of a robust adaptive term much robustifies the SAC system concerning plant uncertainties such as state dependent disturbance. Second, a practical procedure is described for designing the parallel feedforward compensator, which is necessary for the actual realization of the SAC system given prior information concerning the plant such that: (1) the plant is minimum phase; (2) an upper bound on the relative degree exists; and (3) approximate values

of high and low frequency gains are known. The effectiveness of the proposed methods is confirmed through the simulation of typical examples of adaptive control systems. Author

A92-48903#**DERIVATION OF ABCD SYSTEM MATRICES FROM NONLINEAR DYNAMIC SIMULATION OF JET ENGINES**

NANAHISA SUGIYAMA (National Aerospace Laboratory, Chofu, Japan) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit, 28th, Nashville, TN, July 6-8, 1992. 9 p. refs (AIAA PAPER 92-3319) Copyright

A method is presented for deriving a linearized plant model in the form of ABCD system matrices from a nonlinear dynamic simulation. To illustrate the capabilities of the software developed here, ABCD matrices of a two-spool turbofan engine are obtained and compared against actual engine data. The sensitivity to perturbation and the formula used, the linearity of state derivatives, and model uncertainty are discussed. In the example, reasonable results are obtained with 2-percent perturbation and a three-point Lagrange formula. V.L.

A92-49606**FABRICATION OF A BIOLOGICAL VISUAL PERCEPTION SYSTEM USING A MICROLENS ARRAY IN A HYBRID PATTERN RECOGNITION SYSTEM**

SHUN-ICHI KAMEMARU, SHIGERU YAMAGUCHI, and JUN-ICHI YANO (Ibaraki University, Hitachi, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1682-1688. refs Copyright

A concept and a system based on a biological perception system using optical components and a microcomputer are proposed. A breakthrough in the solution of the problem of the interconnection between the optical and digital processing parts is described. The breakthrough has been derived from the technique of separation of the peak signal from noise. Reduction of reflection noise, the effective aperture size of the microlens, and the recognition algorithm are also discussed for the complete recognition system. Experimental results show good feasibility of the proposed system. Author

A92-51792**ROBUST-TRACKING DEADBEAT CONTROL**

YASUYUKI FUNAHASHI and HISAO KATOH (Nagoya Institute of Technology, Japan) International Journal of Control (ISSN 0020-7179), vol. 56, no. 1, July 1992, p. 213-225. refs Copyright

The parameterization of all controllers that achieve both the robust-tracking and the deadbeat control is derived. The parameterization of all reference functions for which the robust tracking and designed deadbeat property is guaranteed by all robust-tracking deadbeat controllers for one reference is also provided. The solution to the robust-tracking deadbeat problem for more than two reference functions is also given. H-infinity norm of the sensitivity function is used as the robustness index of the system. Two-degree-of-freedom control systems are used to achieve both minimal-time deadbeat control and optimal robustness with only one controller. Author

A92-52512**DYNAMICS OF FULLY COMPLEX-VALUED NEURAL NETWORKS**

A. HIROSE (Tokyo, University, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, no. 16, July 30, 1992, p. 1492-1494. refs Copyright

A novel neural network that processes input vectors and attractors fully in complex space using complex weights is proposed. Real and imaginary data are treated consistently with an equivalent significance in nondegenerate complex space. This network can be applied for ill-posed problems concerning realistic physical fields and continuous motion controls. The dynamics are presented and demonstrated. Author

A92-52646**POSITION AND SIZE REPRESENTATIONS BY NEURAL NETWORKS**

KAZUTOSHI GOUHARA (Chubu University, Kasugai, Japan), KATSUJI IMAI (Toyota Motor Corp., Electrical and Electronics Production Div., Japan), and YOSHIKI UCHIKAWA (Nagoya University, Japan) Control and Computers (ISSN 0315-8934), vol. 20, no. 1, 1992, p. 1-5. refs Copyright

In applying the back-propagation (BP) model to visual pattern recognition, two neural networks are proposed which respectively represent the position and the size of the target pattern in the two-dimensional input visual field. It was proved that both of the proposed neural networks have the generalization capability to various shapes of unlearning target patterns. It was discovered that some of the hidden layer units respond selectively to the position and the size of the target pattern in the input visual field, independent of the shape of the target pattern. Computer simulations were carried out in recognizing handwritten characters, and demonstrated that those two neural networks work out satisfactorily for practical use. It was possible to detect the position and the size of the target pattern on the noisy input visual field. Author

A92-53618**EFFICIENT SIMULATION ALGORITHM FOR A SPACE MANIPULATOR**

KATSUHIKO YAMADA (Mitsubishi Electric Corp., Amagasaki, Japan) and KAZUO TSUCHIYA (Osaka University, Suita, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1197-1204. refs Copyright

New simulation algorithms for a space robot (manipulators mounted on a satellite) are proposed. The space robot has $(n+6)$ degrees of freedom in case manipulators have n degrees of freedom. Usually a large amount of computations proportional to $(n+6)$ -squared is necessary to derive equations of motion of the space robot. Efficient algorithms which can solve the equations of motion of the space robot with fewer computations proportional to n are proposed. An algorithm for the case where the manipulator hand is not constrained is shown. The algorithm is extended to the case where the manipulator hand is constrained. The number of computations needed for the algorithms is compared with that of conventional algorithms. The results show that the proposed algorithms require much fewer computations than the conventional algorithms, if the manipulator has many (not less than 6) degrees of freedom. Author

A92-53619**CONTROL OF A TWO-LINK FLEXIBLE ARM**

AKIHIRO MAEKAWA (Mitsubishi Heavy Industries Co., Ltd., System Engineering Dept., Tokyo, Japan), TAKEYA KAWAMURA (Mitsubishi Heavy Industries Co., Ltd.), YUKIO TANAKA (Mitsubishi Heavy Industries Co., Ltd., Kobe Shipyard and Machinery Works, Japan), and SHINYA ISHII (Mitsubishi Heavy Industries Co., Ltd., Takasago Research and Development Center, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1205-1210. refs Copyright

The linear quadratic Gaussian (LQG) method, which combines a Kalman filter and an optimal regulator, is presently used to achieve quick positioning of a two-link flexible manipulator by furnishing its requisite active-damping control. Experimental confirmation is obtained for this discrete-time LQG controller's suppression of vibration; positioning time was reduced to 1/5th of that associated with conventional control. An analysis is conducted of the LQG controller's stability against spillover in the frequency domain. O.C.

A92-53785

IMPROVEMENT OF ATMOSPHERIC FLIGHT PERFORMANCE OF A SPACE VEHICLE THROUGH H INFINITY-CONTROL THEORY

YUKINOBU NAKAMURA (Kyoto University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2349-2354. refs
Copyright

This paper considers a problem of improving controlled atmospheric flight performance of a winged space vehicle, and seeks simplicity of procedure in controller synthesis. It is shown that the problem is reduced to that of trading off between robustness of stability and sensitivity. Then, the reduced problem is shown to be solved through the H infinity optimal control theory. A new class of weighting functions used in optimization procedure is proposed. Using a weighting function in the class, an appropriate tradeoff is obtained for considering the sensitivity optimization problem. Some numerical simulations using data of a winged space vehicle, support the value of the class of the weighting functions.

Author

A92-55156#

CAPTURE CONTROL RESPONSE WITH VARIABLE GAINS

HIRONORI FUJII and TSUTOMU MURAYAMA (Tokyo Metropolitan Institute of Technology, Hino, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 1. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 40-46. refs
(AIAA PAPER 92-4309) Copyright

A control method of variable feedback gains is studied in this paper to capture an object by means of a space manipulator. The space robot consists of a satellite equipped with one manipulator arm, so the main body of the space robot does not only move to translate but also to rotate in reaction to the manipulations of the manipulator arm. A control method with variable feedback gains is presented based on the point-to-point resolved-acceleration control, and guaranteeing Liapunov stability. This method is applied to reducing the initial control torque. An optimization problem is formulated to find the variable feedback gains to minimize the integrated value of the squared control torques in the case of a two-link manipulator with a fixed base.

Author

A92-55263#

COMPUTATIONAL METHOD FOR MINIMAX OPTIMIZATION IN THE TIME DOMAIN

TOSHIYUKI OHTSUKA and HIRONORI FUJII (Tokyo Metropolitan Institute of Technology, Hino, Japan) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 3. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 1156-1162. refs

(AIAA PAPER 92-4551) Copyright

A computational method is proposed in this paper for a minimax problem in the time domain. A minimax problem for a linear system is formulated and analyzed by vector space methods. The analysis shows that the infimum or a lower bound of the value of the performance index is calculated through supplementary optimization problems, and the minimax problem is solved as an optimization problem with an inequality constraint. The proposed approach provides a simple computational method for the minimax problem. Two numerical examples demonstrate simple implementation of the proposed method.

Author

A92-55265#

A ROBUST GAIN SCHEDULER INTERPOLATED INTO MULTIPLE MODELS BY MEMBERSHIP FUNCTIONS

TOSHIYUKI TANAKA and YASUTAKA AIZAWA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) IN: AIAA Guidance, Navigation and Control Conference, Hilton Head Island, SC, Aug. 10-12, 1992, Technical Papers. Pt. 3. Washington, American Institute of Aeronautics and Astronautics,

1992, p. 1169-1185. refs

(AIAA PAPER 92-4553) Copyright

An approach to the design of a robust gain scheduler for multiple-input multiple-output plant depending on time-varying parameters is presented. The design procedure involves defining membership functions, designing the gain scheduler components, and integrating the components into a gain scheduler. As an example, robust gain scheduled autopilots are designed for the F-8 aircraft using the LQG/LTR technique, frequency shaping, and H-infinity control theory.

V.L.

A92-55426

AN IDENTIFICATION PROCEDURE FOR A SYSTEM WITH A CHOICE OF FEEDBACK STRUCTURES

NORIHIRO GOTO (Kyushu University, Fukuoka, Japan), KAZUO MORIYAMA (Japan Air Lines Co., Ltd., Tokyo), and TOSHIKAZU MOTODA (NEC Corp., Tokyo, Japan) Kyushu University, Faculty of Engineering, Memoirs (ISSN 0023-6160), vol. 52, no. 2, June 1992, p. 171-185. refs

The paper proposes an identification procedure capable of selecting a proper feedback structure from two types of probable feedback structures, a direct output feedback single loop and a feedback system with an inner loop. Utilizing the autoregressive scheme, the procedure makes the singular value analysis of the transfer function matrix from the innovations to the outputs in addition to the correlation analysis of the innovations. A validation work using digital simulation data shows that the procedure makes clear distinction between the two types of feedback structures. The paper also discusses the cases where the procedure does not work successfully.

Author

A92-55925

FEEDBACK STABILIZATION OF LINEAR DIFFUSION SYSTEMS WITH PERIODICALLY SCANNING SENSORS

K. YOSHII and K. HAKOMORI (Tohoku University, Sendai, Japan) IEEE Transactions on Automatic Control (ISSN 0018-9286), vol. 37, no. 7, July 1992, p. 1019-1022. refs

Copyright

The feedback stabilization of linear diffusion systems with periodically scanning sensors is considered. The control inputs to the system are given by the feedback of the Sakawa-type observer output. In this case, since the output operator becomes time-periodic, the characteristic multiplier assignment is used to design the observer, and the bounded perturbation theorem of the evolution operators is used to prove the closed-loop stability.

I.E.

A92-56067

DESIGN OF A FLIGHT CONTROL SYSTEM USING A FEEDBACK-ERROR-LEARNING-TYPE NEURAL NETWORK

KIMIO KANAI, YOSHIMASA OCHI, and KAZUNOBU KATOU (National Defense Academy, Yokosuka, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 294-297. In Japanese. refs

The structure of an artificial neural network (ANN) of feedback-error-learning type is presented. Simulation results are presented, and the effectiveness of the ANN is compared with that of a proportional control system.

Y.P.Q.

N92-16656# Japan Atomic Energy Research Inst., Tokyo.

A DERIVATION OF THE EXPLICIT STRUCTURE OF INNER MATRICES FOR H(INFINITY)-OPTIMIZATION

KATSUO SUZUKI (Japan Atomic Energy Research Inst., Tokyo.), JUNYA SHIMAZAKI (Japan Atomic Energy Research Inst., Tokyo.), and YOSHIKUNI SHINOHARA (Japan Atomic Energy Research Inst., Tokai.) May 1991 44 p In JAPANESE; ENGLISH summary
(DE91-522317; JAERI-M-91-079) Avail: CASI HC A03/MF A01

One of the most important computational procedures in the solution of the H(infinity)-minimization problems is the derivation of inner matrices. This report describes in detail Shaked's method to obtain an explicit expression of the inner matrix and also

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summarizes in the form of computational procedures resulting from this method. In addition, a simple numerical example solved by this method is shown. DOE

N92-20921# Tokyo Univ., Sagami-hara (Japan). Dept. of Aerospace Engineering.

MINIMAX OPTIMIZATION IN THE TIME DOMAIN

TOSHIYUKI OHTSUKA and HIRONORI FUJII *In its Proceedings of the Symposium on Mechanics for Space Flight 1990* p 37-46 Mar. 1991

Avail: CASI HC A02/MF A02

A minimax optimization problem is introduced to design terminal controllers for generic dynamical systems without disturbances. The maximum output of the system is minimized over an interval by the control input with the prescribed maximum amplitude. The settling property of the output can be specified through a transformation of variables. Such important characteristics of the control system appear explicitly in the proposed problem as the maximum amplitude of the output, the maximum amplitude of the control input, and the settling property of the output. Therefore, analytical specification can be obtained to evaluate the controlled response without recourse to numerical simulations. The minimum principle results in the necessary condition for the optimal control input and a two-point boundary layer problem (TPBVP) associated with the minimax optimization. Some analytical features of the TPBVP are discussed, and numerical examples are shown.

Author

N92-21394# Central Research Inst. of Electric Power Industry, Tokyo (Japan).

AUTOMATIC RECOGNITION OF FACILITY DRAWINGS, PART 1

C. NAKAJIMA and T. YAZAWA Apr. 1991 24 p In JAPANESE; ENGLISH summary (DE92-769317; CRIE-Y-90022) Avail: CASI HC A03/MF A01

By applying artificial-intelligence pattern recognition technology, a technology was developed to automatically read the contents of a facility's configuration drawings, and efficiently computerize them. The image identification by the first system stage determines, after optically reading figures automatically, what kind of figures are used in the drawing. The second stage is the meaning-understanding process which identifies the meaning of the drawings and stores them in a data base. The identification was tested using an electronic circuit drawing expressing a binary adder as an example. The image identification process identified correctly the symbols indicating logic elements and the wiring diagram. However, the process committed some erroneous identifications in characters. As a result of comparing a drawing model describing the general circuitry of the binary adder with the result obtained from the above figure identification process, it was found that the meaning-understanding process also makes a correct determination. DOE

N92-22694*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

FUZZY LOGIC APPLICATIONS TO EXPERT SYSTEMS AND CONTROL

ROBERT N. LEA and YASHVANT JANI (Togai InfraLogic, Inc., Houston, TX.) *In NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2* p 159-168 Dec. 1991

Avail: CASI HC A02/MF A04

A considerable amount of work on the development of fuzzy logic algorithms and application to space related control problems has been done at the Johnson Space Center (JSC) over the past few years. Particularly, guidance control systems for space vehicles during proximity operations, learning systems utilizing neural networks, control of data processing during rendezvous navigation, collision avoidance algorithms, camera tracking controllers, and tether controllers have been developed utilizing fuzzy logic technology. Several other areas in which fuzzy sets and related concepts are being considered at JSC are diagnostic systems, control of robot arms, pattern recognition, and image processing.

It has become evident, based on the commercial applications of fuzzy technology in Japan and China during the last few years, that this technology should be exploited by the government as well as private industry for energy savings. Author

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NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

A92-11856

BOUNDARY ELEMENT ANALYSIS SYSTEM UTILIZING DATA BASE FOR G,H MATRICES

HIROYUKI KISU (Nagasaki University, Japan) JSME International Journal, Series I (ISSN 0914-8809), vol. 34, Oct. 1991, p. 446-452. refs

Copyright

With the boundary-element analysis in composite materials in mind, the study describes the details of a data-base-utilizing method paying attention to the similarity of kernel functions. It is ascertained that the coefficient matrices of a region are usable for composing those of another region under the condition that the shape is similar even if the number of divisions differs. This indicates that the coefficient matrices can be composed without a numerical integration scheme so that a drastic reduction in CPU time is expected. On the basis of the results, an analysis system that avails itself of the data base is constructed. The advantages of this system are verified by means of several examples. Author

A92-16071

NEW OVERLAPPING COORDINATION METHODOLOGIES FOR LARGE-SCALE OPTIMIZATION PROBLEMS

TAKASHI SHIMA (Kanazawa Women's College, Japan) Automatica (ISSN 0005-1098), vol. 27, Nov. 1991, p. 1011-1024. refs

Copyright

The computational aspects of hierarchical overlapping coordination are examined, and new coordination methodologies are proposed. Two new methodologies are discussed, a nonfeasible decomposition method and a mixed method, and it is shown that coordination procedures similar to those in the conventional large-scale systems which deal with only one decomposition are possible in the overlapping coordination which deals with multiple decompositions. Author

A92-18386

SURFACE GRID GENERATION BASED ON UNSTRUCTURED GRIDS

MASAHIRO SUZUKI (Institute of Computational Fluid Dynamics, Tokyo, Japan) AIAA Journal (ISSN 0001-1452), vol. 29, Dec. 1991, p. 2262-2264. refs

Copyright

The present novel method for the generation of surface grids for complex configurations achieves adaptive control of mesh-clustering by means of the weight function. In contrast to the well-known elliptic grid generation equations solved in the computational domain, the solving of nonlinear equations is obviated, and orthogonality is satisfied. Attention is given to the steps of surface grid construction; illustrative examples are given. O.C.

A92-30521

DEVELOPMENT OF TWO DIMENSIONAL UNSTRUCTURED GRIDS WITH UPWIND METHODS

YOSHIO FUKUDA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) and I. YAMAMOTO (Institute of Space and Astronautical Science, Sagami-hara, Japan) *IN: Fluid Dynamics Conference, 22nd, Osaka,*

Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 68-71. In Japanese. refs

Numerical calculation of unstructured grids is discussed. Two cases are analyzed based on the MUSCL differentiable limiter of Van Leer. Results of transonic flow calculation are presented.

Y.P.Q.

A92-30553

WIDE ANGLE OF A TWO-DIMENSIONAL CHANNEL WITH EXPANDING FLOW FOR MULTIPLE VERTICAL GRIDS

M. ITO and M. UEDA (Meiji University, Kawasaki, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 200-203. In Japanese.

A wind tunnel test for two-dimensional free air flow is presented. The pressure distribution is measured and the grid drag coefficients are analyzed. The intensity distribution of turbulent flow is addressed.

Y.P.Q.

A92-36837

CONSTRUCTION OF MODIFIED THIRD-ORDER UPWIND SCHEMES FOR STRETCHED MESHES

SUSUMU SHIRAYAMA (Institute of Computational Fluid Dynamics, Tokyo, Japan) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1237-1242. Previously cited in issue 07, p. 1104, Accession no. A91-21599. refs

Copyright

A92-45717

REGULARIZED MAXIMUM LIKELIHOOD ESTIMATE FOR AN INFINITE-DIMENSIONAL PARAMETER IN STOCHASTIC PARABOLIC SYSTEMS

SHIN I. AIHARA (Tokyo, Science University, Chino, Japan) SIAM Journal on Control and Optimization (ISSN 0363-0129), vol. 30, no. 4, July 1992, p. 745-764. refs

Copyright

An algorithm for generating the maximum likelihood estimate (MLE) is developed which is based on the regularization technique (Kravaris and Seinfeld, 1985). Necessary conditions for the regularized MLE (RMLE) are derived using the 'adjoint equation' (Lions, 1971). An iterative algorithm to find a solution that satisfies the necessary conditions for the RMLE is proposed and the convergence of the generated sequence to the RMLE is shown.

O.G.

A92-47068

DELAUNAY-BASED GRID GENERATION FOR 3D BODY WITH COMPLEX BOUNDARY GEOMETRY

TAKEO TANIGUCHI and CHIKASHI OHTA (Okayama University, Japan) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 533-543. refs

Copyright

A new grid generation method for an arbitrary 3D body with complex boundary geometry and smooth surface is proposed which is capable of generating tetrahedra using only the information on nodes set by users. The Delaunay triangulation is used to subdivide the domain into tetrahedra using nodes located inside. Input data include the coordinates of nodes set inside the 3D body and on its surface.

O.G.

A92-47069

SIMPLE DIAGNOSIS FOR THE QUALITY OF GENERATED GRID SYSTEMS

SUSUMU SHIRAYAMA (Institute of Computational Fluid Dynamics, Tokyo, Japan) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 547-555. refs

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A simple diagnosis is proposed for the quality of a grid system in a flow solver based on generalized curvilinear coordinates. It is shown that an efficient improvement of the grid system is accomplished by using this diagnosis. The diagnosis consists of three parts: searching a model equation which has a characteristic feature of the Navier-Stokes equations, solving the model equation effectively, and identifying the region to be improved. One grid system modification cycle is complete with this diagnosis in a few minutes using a scalar computer with a speed of about 5 MFLOPS.

C.D.

A92-47094

AN APPROACH TO THE SURFACE GRID GENERATION BASED ON UNSTRUCTURED GRID

MASAHIRO SUZUKI (Institute of Computational Fluid Dynamics, Tokyo, Japan) IN: Numerical grid generation in computational fluid dynamics and related fields; Proceedings of the 3rd International Conference, Barcelona, Spain, June 3-7, 1991. Amsterdam and New York, North-Holland, 1991, p. 947-953. refs

Copyright

A method of generating smooth surface grids from unstructured grids is demonstrated. Adaptive control of mesh clustering is achieved using the weight function. A simple example is used to show that this technique can handle structural analysis of large deformations with fluid forces.

C.D.

A92-49161

EVOLUTION PROBLEMS

HIROSHI FUJITA (Meiji University, Kawasaki, Japan) and TAKASHI SUZUKI (Tokyo Metropolitan University, Japan) IN: Handbook of numerical analysis. Vol. 2. Amsterdam and New York, North-Holland, 1991, p. 789, 791-928. refs

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A mathematical study of the finite element method as applied to evolution problems is presented. The analysis is basically operator-theoretical, from the viewpoint of evolution equations in Banach spaces. Since the arguments on approximation as well as on the original problem in the continuous version rely heavily on the study of elliptic boundary value problems and their finite element approximations, these are briefly reviewed at the beginning. The application of semigroup theory in the finite element method for initial value problems is then discussed. Error analysis by real methods is developed for the case of temporally inhomogeneous parabolic equations. Finally, some refinements and generalizations are made, some variants of the finite element method are given, and applications to nonlinear problems are shown.

A.F.S.

A92-51099

EXTERIOR MOMENT METHOD ANALYSIS OF CONDUCTING SCATTERERS BY USING THE INTERIOR GREEN'S FUNCTION AND THE METHOD OF LEAST SQUARE

K. SAWAYA (Tohoku University, Sendai, Japan), S. YATABE (Nippon Steel Corp., Plant Engineering and Technology Center, Futtsu, Japan), and S. ADACHI (Tohoku University, Sendai, Japan) IEEE Transactions on Antennas and Propagation (ISSN 0018-926X), vol. 40, no. 5, May 1992, p. 563-565. Research supported by Tanaka Science Foundation. refs

Copyright

The method of least squares is incorporated into a technique by Sawaya et al. (1990) in which the interior Green's function is employed to determine the mutual admittance matrix in the moment method analysis. The number of test functions is set less than the number of assumed sources, and the method of least squares is used to calculate the admittance matrix. Good results are reported for an example in which a 2D magnetic strip source is located on the exterior of a conducting rectangular cylinder.

C.C.S.

A92-52790

MODIFICATION OF NANBU'S METHOD OF DSMC BY USING THE NULL-COLLISION TECHNIQUE

TAKASHI ABE (Institute of Space and Astronautical Science,

64 NUMERICAL ANALYSIS

Sagamihara, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 929-936. refs

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The paper proposes a modification of Nanbu's method by using the null collision technique. This modification increases the computation efficiency. That is, after the modification, the computational time is almost proportional to the number of molecules, although the original Nanbu's method consumes a computational time almost proportional to the square of the number of molecules. The computational efficiency is comparable to other widely accepted methods such as the time counter method. Applying the new method to a relaxation problem, it was found that the present method can give a reasonable solution comparable to other methods widely accepted. Author

A92-55451

AUTOMATIC DISCRETIZATION OF A THREE-DIMENSIONAL DOMAIN INTO VORONOI POLYHEDRON ELEMENTS
MUTSUO KOBAYASHI, HIROSHI MAEKAWA, and YASUHIRA KONDOU (Niigata University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 35, no. 3, Aug. 1992, p. 337-345. refs

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When a partial differential equation is solved numerically, it is conventional to discretize the calculating domain into many elements by elaborate handwork. For this discretization a new method with which the three-dimensional domain can be automatically divided into Voronoi polyhedron elements enclosing arbitrary nuclear points is devised. The present report describes this method in detail giving an example. When the Voronoi polyhedron elements are used, various types of differential equations can be easily transformed into simultaneous algebraic equations for each of the nuclear points, and parallel processing can be achieved more quickly and accurately. Moreover, the Voronoi polyhedron element table has possibilities for future development: it can be used not only as a direct analytical method of solving a partial differential equation, but also, after being transformed, as an ordinary tetrahedron element table. Author

N92-16668# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

TOPOLOGICAL CONFORMAL ALGEBRA AND BRST ALGEBRA IN NON-CRITICAL STRING THEORIES

KAZUO FUJIKAWA and HIROSHI SUZUKI Mar. 1991 19 p (DE91-508298; YITP/U-91-17) Avail: CASI HC A03/MF A01

The operator algebra in non-critical string theories is studied by treating the cosmological term as a perturbation. The algebra of covariantly regularized BRST and related currents contains a twisted $N = 2$ superconformal algebra only at $d = -2$ in bosonic strings, and a twisted $N = 3$ superconformal algebra only at $d = +$ or $-$ infinity in spinning strings. The bosonic string at $d = -2$ is examined by replacing the string coordinate by a fermionic matter with $c = -2$. The resulting bc-beta gamma system accommodates various forms of BRST cohomology, and the ghost number assignment and BRST cohomology are different in the $c = -2$ string theory and two-dimensional topological gravity. DOE

N92-32205# National Inst. for Fusion Science, Nagoya (Japan). **KERNEL OPTIMUM NEARLY-ANALYTICAL DISCRETIZATION (KOND) METHOD APPLIED TO PARABOLIC EQUATIONS KOND-P SCHEME**

Y. KONDOH (Gunma Univ., Japan) and Y. HOSAKA (Gunma Univ., Japan) Nov. 1991 25 p Submitted for publication (ISSN 0915-633X)

(NIFS-118) Avail: CASI HC A03/MF A01

A KOND-P scheme, which is the application of the Kernel Optimum Nearly-analytical Discretization (KOND) method for the construction of numerical schemes to the parabolic type partial differential equation, is presented. Typical numerical results are shown to clarify that the KOND-P scheme is more accurate than

the conventional explicit scheme by 2-3 orders of magnitude, as measured by the root mean square deviation from analytical solutions. Author

65

STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

A92-19822

EFFECT OF SAMPLE SIZE ON FAILURE PROBABILITY IN BOTH WEIBULL AND LOG-NORMAL PROBABILITY MODELS

H. ISHIKAWA, H. INOMO (Kagawa College of Technology, Japan), A. UTSUMI (Governmental Industrial Research Institute, Shikoku, Japan), and H. ISHIKAWA (Kagawa University, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 2277-2282. refs

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The paper deals with distribution properties of the statistical failure probability constructed with the aid of parameter estimators for both Weibull and log-normal distributions. Comparison is made between shapes of the distribution function of the statistical failure probability for these probability models. Discussions are presented regarding how to determine the optimum sample size of the fatigue experiment in order to meet the prescribed reliability level imposed on structural components. This can be used to perform the reliability-based fatigue-proof design based upon a practical viewpoint through correct evaluation of engineering uncertainties caused by use of a limited number of experimental data. Author

A92-53594

NEW PREDICTION ALGORITHM USING COVARIANCE INFORMATION IN LINEAR CONTINUOUS SYSTEMS

SEIICHI NAKAMORI (Kagoshima University, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 1. Tokyo, ACNE Publishing, Inc., 1990, p. 1027-1032. refs

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A prediction algorithm is presented that uses covariance information directly from the signal and the noise for white Gaussian and colored observation noise in linear continuous stochastic systems. The linear least-squares prediction problem is examined, and the optimal prediction algorithm is devised giving the recursive fixed-lead prediction method. The predictor is applied to a digital simulation of signal processes and accompanying observational noise. The method is argued to be efficient because the covariance information need not be factorized in the semidegenerate kernel form. The system parameters of the state-space model can be derived effectively with the method. The technique is shown to be useful for applications to predicting atmospheric pollution levels with actual data. C.C.S.

N92-33701# National Inst. for Fusion Science, Nagoya (Japan). **A METHOD FOR THE HIGH-SPEED GENERATION OF RANDOM NUMBERS WITH ARBITRARY DISTRIBUTIONS**

T. ISHIKAWA (Gunma Univ., Maebashi, Japan), P. Y. WANG (Gunma Univ., Maebashi, Japan), K. WAKUI (Gunma Univ., Maebashi, Japan), and T. YABE (Gunma Univ., Maebashi, Japan) Nov. 1991 28 p Sponsored in part by Ministry of Education, Science and Culture (ISSN 0915-633X)

(NIFS-121) Avail: CASI HC A03/MF A01

A new method for the high-speed generation of random numbers with arbitrary distributions is proposed. The method stores random numbers in two memories, and then picks out two random numbers and assembles them, resulting in a new random number. When

the method is realized with Fortran, the method can generate random numbers with normal distribution about eleven times faster than methods that use the central limit theorem and can generate random numbers with Planck distribution about nine times faster than the acceptance-rejection method. The method is realized by hardware. The system generates $5(10)(\exp 6)$ random numbers per second with any distribution. The statistical quality of these random numbers is similar to or better than that of conventional methods.

Author

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SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

A92-23705

AN INVESTIGATION OF MISSION SCHEDULING SYSTEM FOR THE JAPANESE EXPERIMENT MODULE

MASAO KOBAYASHI, YUICHI NAKAYAMA (Fujitsu, Ltd., Tokyo, Japan), MASAMI ICHIHARA (Fujitsu Social Science Laboratory, Ltd., Tokyo, Japan), HIROSHI YAMASHITA, and KENTARO KUROIWA (Mathematical Systems Institute, Inc., Tokyo, Japan) IN: *i-SAIRAS '90: Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space*, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 237-240.

The planning for the execution of space experiments on the Japanese Experiment Module attached to Space Station Freedom requires that a great many missions are effectively allocated within a fixed time span. In the past, a prototype system, named 'Mises II', for short-term planning by using a heuristic method was developed. Then the target to a middle-term planning system was extended, and developed two prototype systems, 'Mises III' which is based upon a heuristic method, and 'Maestro' which uses a numerical optimization method. Both systems will combine aiming at the development of a mission scheduling system for practical use.

Author

A92-23710

SIMULATION SYSTEM FOR TELE-OPERABILITY EXPERIMENTS OF FREE-FLYING SPACE ROBOTS

YASUHIRO MASUTANI and FUMIO MIYAZAKI (Osaka University, Toyonaka, Japan) IN: *i-SAIRAS '90: Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space*, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 263-266. refs

To examine the teleoperability of free-flying space robots, a computer simulation system is developed. This system, consisting of human interface devices, a dynamics model, a graphics model, and a subcontroller can simulate the teleoperated mission on the orbit in real-time. An operator gives commands to the robot with a joystick as he observes camera images simulated in the graphic display. The dynamics model is used to take into consideration dynamic coupling between the manipulator and its base body (spacecraft). The graphics model is employed to present a three-dimensional work area to an operator with stereo vision. As an example of teleoperability experiments, the effectiveness of some types of subcontrollers through a positioning task is compared. These controllers use the conventional or generalized Jacobian matrices to transform the operator's velocity command in the task-oriented coordinates into that in terms of the manipulator joint space.

Author

N92-24783# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

MISSION OPERATIONS OF THE SPACECRAFT HITEN

K. UESUGI (Tokyo Univ. (Japan).), J. KAWAGUCHI (Tokyo Univ. (Japan).), N. ISHII (Tokyo Univ. (Japan).), M. SHUTO (Tokyo Univ.

(Japan).), M. KAMIMURA (Nippon Electric Co. Ltd. (Japan).), N. MURANAKA (Nippon Electric Co. Ltd. (Japan).), M. UO (Nippon Electric Co. Ltd. (Japan).), M. OGASAWARA (Nippon Electric Co. Ltd. (Japan).), A. KIMURA (Nippon Electric Co. Ltd. (Japan).), S. ISHII (Nippon Electric Co. Ltd., Japan) et al. In *ESA, Spacecraft Flight Dynamics* p 465-470 Dec. 1991

Copyright Avail: CASI HC A02/MF A06; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The launch on 24 Jan. 1990 of the space engineering satellite 'Hiten' is addressed. The Hiten primary mission goals are to verify technologies and techniques required for lunar and planetary missions in the near future. These include orbit control of Hiten utilizing multiple gravity assist lunar swingbys of the Moon, insertion of an orbiter into lunar orbit and aerobraking technology demonstrations in the Earth's atmosphere. A sophisticated mission design and its flexible operational schemes developed to accomplish these complicated missions are summarized. They are reported to have worked well through the Hiten's successful nine lunar swingby orbiting the lunar orbiter Hagoromo around the moon and the Hiten's two aerobrake demonstrations.

ESA

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THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-16696# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

ON THE MONODROMY GROUP FOR THE SUPER SCHWARZIAN DIFFERENTIAL EQUATION

SHOZO UEHARA and YUKINORI YASUI Mar. 1991 20 p (DE91-508301; YITP/U-91-18) Avail: CASI HC A03/MF A01

We calculate the first variation of the monodromy group associated with a super Schwarzian differential equation. The relation between the monodromy period and the Fenchel-Nielsen deformation of a super Riemann surface is presented.

DOE

N92-70618 Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

NOTE ON 3-DIMENSIONAL REGGE CALCULUS

JIRO SODA (Hiroshima Univ., Japan) Jan. 1991 13 p (DE92-750829; YITP/U-91-5) Avail: CASI HC A03/MF A01

We shall study 3-dimensional Regge calculus with concentrating the role of the Bianchi identity. As a result, the number of the physical variables is determined to be $12g - 12$ (g less than 1). The reason why Rocek and Williams derived the exact result of Deser, Jackiw and 'tHooft is clarified.

DOE

70

PHYSICS (GENERAL)

A92-13451

NONERGODIC BEHAVIOR IN A SYSTEM OF COUPLED NONLINEAR OSCILLATORS

TOYONORI MUNAKATA (Kyoto University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2800-2804. refs

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The static and dynamic properties of a nonlinear stochastic model are studied both theoretically and numerically. A system of nonlinear oscillations is considered whose free energy is expressed in a suitably dimensionless form. The trilinear interaction among three oscillators is chosen to be of mean-field type, which makes

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it possible to make a mean-field analysis and to simplify the numerical simulation of the Langevin equation which describes the relaxation dynamics of the system with the free energy.

O.G.

A92-13457

COHERENCE AND FLUCTUATIONS OF THE ELECTROMAGNETIC FIELD

HIDEJIRO TANAKA (Waseda University, Tokyo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2922-2931. refs
Copyright

The first-order coherence condition is derived in terms of correlations between different field modes. Fluctuations of the electromagnetic field are shown to play an important role in the concept of coherence. The coherent states are shown to be the only ones which reduce these fluctuations to their minimum value. For the case of a field in which the different field modes are independent, the degree of first-order coherence and the visibility of interference fringes are shown to be specified completely by these fluctuations. Measurements of this visibility yield information on the statistical properties of radiation fields. For squeezed states, this visibility is expressed as a function of squeezed parameters. Moreover, the difference between generalized coherent states becomes manifest in measurements of this visibility. Author

A92-20503

SMALL AMPLITUDE SOLUTIONS OF THE DYNAMO PROBLEM. I - THE ADJOINT SYSTEM AND ITS SOLUTIONS

MASARU KONO (Tokyo Institute of Technology, Japan) and PAUL H. ROBERTS (California, University, Los Angeles) Journal of Geomagnetism and Geoelectricity (ISSN 0022-1392), vol. 43, no. 10, 1991, p. 839-862. Research supported by University of California. refs
(Contract NSF EAR-91-04924)
Copyright

As part of an investigation directed to find small amplitude solutions of the MHD dynamo problem, the adjoint eigenvalue system was derived for the kinematic dynamo problem including the alpha-effect. The adjoint system was deduced both for spherical dynamos and for dynamos operating in containers of general form. Results demonstrate the agreement between the eigenvalues of the two systems and between those reported in earlier integrations, as well as the closeness of the eigenvalues of the dipole and the quadrupole types for alpha-square dynamos. I.S.

A92-23457

SURVEY OF REGULAR AND CHAOTIC PHENOMENA IN THE FORCED DUFFING OSCILLATOR

YOSHISUKE UEDA (Kyoto University, Japan) Chaos, Solitons and Fractals (ISSN 0960-0779), vol. 1, no. 3, 1991, p. 199-231. refs
Copyright

The fundamental concepts of discrete dynamical systems theory is briefly explained in relation to nonlinear differential equations of the second order, and particular results for the Duffing oscillator are surveyed. The maximal bounded invariant set and central motions, the fixed and periodic points and related properties, and the doubly asymptotic points and related properties of the Duffing oscillator are examined. The results of analog and digital simulations of the Duffing oscillator and their interpretation are discussed. C.D.

A92-23459

THE THEORY AND APPLICATIONS OF THE UNSTABLE NONLINEAR SCHRÖDINGER EQUATION

MIKI WADATI, TETSU YAJIMA, and TAKESHI IIZUKA (Tokyo, University, Japan) Chaos, Solitons and Fractals (ISSN 0960-0779), vol. 1, no. 3, 1991, p. 249-271. refs
Copyright

Recent work on the unstable nonlinear Schrödinger (UNS) equation is reviewed. An analysis and derivation of the UNS are given, and the initial value problem is solved by the inverse

scattering method and used to obtain the N soliton solution. It is shown that the position shifts due to the collisions have opposite signs compared with the conventional nonlinear Schrödinger equation. The Rayleigh-Taylor instability problem and electron beam plasma systems are examined and it is shown that, for both systems near the critical wave number region, wave amplitude obeys the UNS equation. C.D.

A92-33351

FRactal STRUCTURE OF TWO-DIMENSIONAL GRAVITY COUPLED TO $c = -2$ MATTER

N. KAWAMOTO (Kyoto University, Japan), V. A. KAZAKOV (Ecole Normale Supérieure, Paris, France), Y. SAEKI, and Y. WATABIKI (Kyoto University, Japan) Physical Review Letters (ISSN 0031-9007), vol. 68, April 6, 1992, p. 2113-2116. refs
Copyright

The results of numerical calculations of internal fractal dimensions of a dynamically triangulated 2D gravity coupled to $c = -2$ matter are presented. Internal fractal dimensions as a function of the internal geodesic distance are measured from the number of boundaries and the total length of boundaries, and show clear scaling behavior, while the number of triangles starts to scale only around the maximum size. A recursive sampling algorithm for $c = -2$ is applied, which makes it possible to generate the most probable triangulations of spherical topology, consisting of 5×10^6 triangles. Author

A92-33669

CHARACTERISTICS OF X-RAY RADIATION BY A NONEQUILIBRIUM ENERGETIC ELECTRON FLOW EMERGED FROM A FORMED FERRITE FILAMENT

K. WATANABE, K. FURUSHO, S. KASHIWABARA, and R. FUJIMOTO (National Defense Academy, Yokosuka, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 68, Nov. 15, 1990, p. 5059-5063. refs
Copyright

This article reports the observation of intense X-ray emission by a nonequilibrium energetic electron flow that can be produced when an explosive-formed ferrite filament is used as a plasma initiator in a high vacuum of 10^{-5} - 10^{-3} torr. Exposure dose measurements and pinhole photographs for the X-ray emission have shown that X-rays originate linearly along a 14.5-cm filament with a high exposure dose level of 50 mR(mroentgen)/pulse at 6.5 keV, the predominant X-ray energy. The X-ray emission characteristics are described in terms of the time-resolved and integrated observations in order to infer the X-ray emission mechanism in which an interaction between energetic electron flow and a cloud of ions or neutral atoms thermally produced from the filament has to be taken into account in the close vicinity of the filament. Author

A92-34729

DYNAMICS AND QUANTIZATION OF HAMILTONIAN CHAOS - DENSITY OF STATES IN PHASE-SPACE SEMICLASSICAL MECHANICS

KAZUO TAKATSUKA (Nagoya University, Japan) Physical Review A (ISSN 1050-2947), vol. 45, pt. A, April 1, 1992, p. 4326-4339. Research supported by MOESC. refs
Copyright

An extended expression of the density of states for Hamiltonian chaos is derived. A phase-space semiclassical mechanics approach is used to construct independently the expression for both regular and irregular spectra in a unified manner. It is shown that the Liapunov exponent, Greene's residue in classical chaos, and the Maslov index in the EBK conditions are closely related to one another through the amplitude factor of the phase-space kernel. In addition, a formal aspect of the thermodynamic characterization of quantum chaos is addressed, defining the dynamical temperature and entropy through the analytic structure of the density of states. L.M.

A92-38045

RESONANT INTERACTION BETWEEN LINE SOLITON AND Y-PERIODIC SOLITON - SOLUTIONS TO THE KADOMTSEV-PETVIASHVILI EQUATION WITH POSITIVE DISPERSION

YOUICHI MURAKAMI and MASAYOSHI TAJIRI (Osaka Prefecture, University, Sakai, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 791-805. refs
Copyright

The exact solutions to the Kadomtsev-Petviashvili equation with positive dispersion are analyzed to study the interaction between line soliton and y-periodic soliton (i.e., the array of the localized structures in the y direction, which propagates in the x direction). The interactions are classified into several types according to the phase shifts due to collision. There are two types of singular interactions: one is the resonant interaction that generates one line soliton, while the other is the extremely repulsive or long-range interaction where two solitons interchange each other infinitely apart. Both interactions are associated with the parametric points on the boundary between the regions, where the transverse phase shift can occur and that for no transverse phase shift. Interactions are illustrated graphically, and the differences from the singular interactions in other cases are described. Author

A92-42398

MECHANICAL TRANSFER FUNCTION OF A PENDULUM SUSPENDED WITH A FINITE-MASS WIRE

NORIKATSU MIO (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1243, 1244. refs
Copyright

The mechanical transfer functions of a pendulum suspended with a finite-mass wire are calculated, and their characteristics are discussed in terms of the normal-mode expansion method. The pendulum is treated as a wire of a given length and uniform linear mass density, with a point mass attached to the end of the wire. The results are of significance for the construction of a free-mass gravitational wave detectors, in which pendulum suspension is one of the prominent parts. I.S.

A92-46342

TIME-EVOLVED NUMERICAL SIMULATION OF A TWO-DIMENSIONAL ELECTRON WAVE PACKET THROUGH A QUANTUM POINT CONTACT

AKIRA ENDOH, SHIGEHICO SASA, and SHUNICHI MUTO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 1, July 6, 1992, p. 52-54. refs
Copyright

Time-evolved numerical simulation of a 2D electron wave packet through a quantum point contact was performed using the finite difference method to simulate the diffraction phenomenon of a single electron. It is found that the transmitted wave packet has diffracted subpeaks which show the following properties: (1) the traces of diffracted subpeaks start from the center of the slit entrance; (2) lateral wave number of diffracted subpeaks is quantized; (3) the diffraction angles are determined by slit width and the initial electron wave packet energy; (4) the number of allowed diffracted subpeaks is determined by potential barrier thickness; and (5) there is a delay in the motion of diffracted subpeaks due to quantization inside the slit. Author

A92-50111

GLOBAL TRAVELING WAVE TRIGGERED BY LOCAL PHASE SLIPS

KUNIHICO KANEKO (Tokyo, University, Japan) Physical Review Letters (ISSN 0031-9007), vol. 69, no. 6, Aug. 10, 1992, p. 905-908. Research supported by MOESC. refs
Copyright

A novel type of traveling-wave attractor is found in coupled-map lattices. Attractors with different velocities coexist, which are coded by the asymmetry of the wave form. Admissible velocities for the attractors form a series of bands. The velocity is proportional to the winding number of phase slips. If the wavelength and the

system size do not match, the wave is modulated by low-dimensional chaos, which leads to spontaneous velocity switching by frustration or reverse transmission of chaotic modulation. Author

A92-52603

CHAOTIC DYNAMICS OF QUASI-PERIODICALLY FORCED OSCILLATORS DETECTED BY MELNIKOV'S METHOD

KAZUYUKI YAGASAKI (Tamagawa University, Machida, Japan) SIAM Journal on Mathematical Analysis (ISSN 0036-1410), vol. 23, no. 5, Sept. 1992, p. 1230-1254. refs
Copyright

Nonlinear oscillators that have the form of quasi-periodic perturbations of planar Hamiltonian systems with homoclinic orbits are studied. For such systems, Melnikov's method permits determination, up to the leading term, whether or not the stable and unstable manifolds of normally hyperbolic invariant tori intersect transversely. In a more general setting it is proven that such intersection results in chaotic dynamics. These chaotic orbits are characterized by a generalization of the Bernoulli shift. An example is given to illustrate the theory. The result is also compared with the results of Wiggins (1988), Scheurle (1986), and Meyer and Sell (1989). Author

N92-30498# National Inst. for Fusion Science, Nagoya (Japan).

ROLE OF COMPRESSIBILITY ON DRIVEN MAGNETIC RECONNECTION

T. SATO, T. HAYASHI, K. WATANABE, R. HORIUCHI, M. TANAKA, N. SAWAIRI (Hiroshima Univ., Japan), and K. KUSANO (Hiroshima Univ., Japan) Aug. 1991 32 p
(ISSN 0915-633X)

(NIFS-105) Avail: CASI HC A03/MF A01

Whether it is induced by an ideal (current driven) instability or by an external force, plasma flow causes a change in the magnetic field configuration and often gives rise to a current intensification locally, resulting in a fast driven reconnection there. Many dramatic phenomena in magnetically confined plasmas such as magnetospheric substorms, solar flares, MHD self-organization, and tokamak sawtooth crash, may be attributed to this fast driven reconnection. Using a fourth order MHD simulation code, it is confirmed that compressibility of the plasma plays a crucial role in leading to a fast (MHD time scale) driven reconnection. This indicates that the incompressible representation is not always applicable to the study of the global dynamical behavior of a magnetically confined plasma. Author

N92-30983# National Inst. for Fusion Science, Nagoya (Japan).

THE ROLE OF STOCHASTICITY IN SAWTOOTH OSCILLATION

ALLAN J. LICHTENBERG (California Univ., Berkeley.), KIMITAKA ITOH, SANAE-I. ITOH, and ATSUSHI FUKUYAMA (Okayama Univ., Japan) Aug. 1991 79 p
(ISSN 0915-633X)

(NIFS-103) Avail: CASI HC A05/MF A01

Stochastization of field lines, resulting from the interaction of the fundamental $m/n = 1/1$ helical mode with other periodicities, plays an important role in sawtooth oscillations. The time scale for the stochastic temperature diffusion is shown to be sufficiently fast to account for the fast sawtooth crash. The enhanced electron and ion viscosity, arising from the stochastic field lines, are calculated. The enhanced electron viscosity always leads to an initial increase in the growth rate of the mode, the magnetic trigger. The enhanced ion viscosity can ultimately lead to mode stabilization before a complete temperature redistribution or flux reconnection has occurred. A dynamical model is introduced to calculate the path of the sawtooth oscillation through a parameter space of shear and amplitude of the helical perturbation, including a stochastic trigger to an enhanced growth rate, stabilization by ion viscosity, and a prescription for flux reconnection at the end of the growth phase. Our model predicts that four types of the sawtooth oscillations are possible even for a plasma with monotonic $q(r)$ profile. There are two types of rearrangement of the magnetic configuration: a partial-magnetic reconnection, in which the safety

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factor on axis $q(0)$ value oscillates around 0.7 with $\delta q(0)$ approx. equal to 0.05; and a full magnetic reconnection, for which $q(0)$ oscillated between 1 and about 0.8. In a partial reconnection the temperature flattening is rapid and can be either limited to an annulus near the $q = 1$ rational surface, which then gradually propagates to the axis, or the temperature on axis $T(\text{sub } e)(0)$ can rapidly decay, when the stochastic region invades the geometrical axis. With a full magnetic reconnection, $T(\text{sub } e)(0)$ collapses rapidly when stochasticity is present or slowly without stochasticity. The main features of the model are compared with experimental observations. In particular, they may explain the sudden growth of the helical perturbation, the magnetic trigger, the fast time scale of the temperature collapse, a partial temperature collapse, and the persistence of an $m/n = 1/1$ island throughout the sawtooth cycle. Author

N92-33384* Ministry of Posts and Telecommunications, Ibaraki (Japan). Communications Research Lab.

MILLISECOND PULSAR OBSERVATION SYSTEM AT CRL

YUKO HANADO, H. KIUCHI, S. HAMA, A. KANEKO, and M. IMAE / In NASA. Goddard Space Flight Center, Proceedings of the 23rd Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting p 377-383 Jul. 1992

Avail: CASI HC A02/MF A04

Millisecond pulsars have attracted attention as future reference clocks in place of present atomic clocks. The Communications Research Laboratory (CRL) has been developing an observation system to measure the pulse timing of a millisecond pulsar precisely, and has recently completed the basic part of the task. We observed PSR1937+21 at 1.5GHz band and got a pulse timing with a precision of 16 micro sec/tau by five days of observation. Author

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ACOUSTICS

Includes sound generation, transmission, and attenuation.

A92-15357

ANALYTICAL STUDY ON PLATE EDGE NOISE - TRAILING EDGE NOISE CAUSED BY VORTICITY WAVES

KOJI TAKAHASHI and SHOJIRO KAJI (Tokyo, University, Japan) JSME International Journal, Series II (ISSN 0914-8817), vol. 34, Nov. 1991, p. 431-438. refs

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An analysis is performed on the trailing edge noise, one of the important mechanisms of noise generation in flow machines. An acoustic field is treated where a semi-infinite flat plate is placed parallel to the inviscid uniform flow with incident vorticity waves convected from the upstream direction. The Wiener-Hopf technique is used to obtain an exact solution to the sound pressure proportional to the amplitude of the incident vorticity wave without restriction of frequency or velocity. The calculated acoustic field, which varies with flow velocity, exhibits general features of the sound pressure level (SPL) in a cardioid pattern with the constant phase surface distorted by the main flow. The relationship between flow velocity and SPL is ascertained to be dependent on the 5th law at low Mach numbers. However, the results show that such dependence does not hold at higher Mach numbers where the radiated noise level rises progressively as the flow velocity increases. Author

A92-16467

VORTICITY PRODUCTION AT THE EDGE OF A SLIT BY SOUND WAVES IN THE PRESENCE OF A LOW-MACH-NUMBER BIAS FLOW

YASUhide FUKUMOTO and MITSUHIRO TAKAYAMA (Nagoya University, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 3,

Dec. 1991, p. 3080-3082. refs

Copyright

Vorticity production by low-frequency sound waves impinging on a screen perforated with a slit is studied in the presence of a steady low-Mach-number mean flow through it. A Kutta condition is invoked at the rim of the slit to determine the strength of the shed vortex sheets. It is found that, unlike the case of a circular aperture, the strength depends not only on the Strouhal number but also on the Mach number. An attempt is made to apply the results to the problem of transmission of sound waves through a uniformly perforated screen. Author

A92-19808

IMPROVEMENT OF MEASURING ACCURACY OF ULTRASONIC ATTENUATION OF DEGRADED MATERIALS USING SPECTRUM ANALYSIS

SHINSUKE SAKAI, HIROYUKI OKAMURA, TACHIO TAKANO (Tokyo, University, Japan), NOBUHIRO FUJINAWA (Nikon Corp., Tokyo, Japan), MASAOKI MATSUBARA, and AKITO NITTA (Central Research Institute of Electric Power Industry, Tokyo, Japan) IN: Fatigue 90; Proceedings of the 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, July 15-20, 1990. Vol. 4. Birmingham, England, Materials and Component Engineering Publications, Ltd., 1990, p. 1985-1990.

Copyright

A new algorithm for improvement of measuring accuracy of ultrasonic attenuation using a spectrum analysis has been developed. The algorithm developed is incorporated in a measuring system which consists of a personal computer with ultrasonic apparatus and a digital storage oscilloscope. It is concluded that the measuring accuracy of ultrasonic attenuation by the present method is higher than that by the normal method. Author

A92-21723

ACOUSTIC FIELDS IN VARIABLE AREA DUCTS WITH HIGH SUBSONIC FLOWS

YASUJI TSUBAKISHITA, TAKAO YOSHIKAWA (Osaka University, Japan), and AKIRA FUJII (Toyota Motor Corp., Japan) Japan Society for Aeronautical and Space Sciences, Transactions (ISSN 0549-3811), vol. 34, Nov. 1991, p. 167-176. refs

A numerical analysis is developed for the propagation of acoustic waves in a variable area duct which contains a high subsonic throat Mach number. The multi-dimensional structures of the sound fields are numerically obtained for several duct profiles. The governing equation for acoustic disturbances is a linearized unsteady Euler equation about a steady compressible mean flow. The numerical simulation is conducted by a fourth-order accurate finite difference scheme. The result indicates that the acoustic theory for the sound propagation upstream through the nonuniform mean flow should be based on a multi-dimensional model, not on a quasi-one-dimensional one. The result also shows that the nonuniform and rotational mean flow substantially reduces the acoustic power. Author

A92-21974

CHANGE OF OSCILLATION MODES OF CIRCULAR UNDEREXPANDED JET BY IMPINGEMENT ON A SMALL PLATE

YOSHIKUNI UMEDA, RYUJI ISHII (Kyoto University, Japan), and ALAN POWELL (Houston, University, TX) Kyoto University, Faculty of Engineering, Memoirs (ISSN 0023-6063), vol. 53, Oct. 1991, p. 195-214. Research supported by Sound Technology Promotion Foundation, Kyoto University, Texas Advanced Research Program, et al. refs

(Contract MOESC-03805007)

Results are presented on measurements of frequency characteristics of the discrete tones radiated out when a circular underexpanded jet impinged on a small circular plate, that were carried out when the plate was moved along the jet axis at eleven fixed pressure ratios of the jet. Results showed that the discrete tones can be divided into two groups, belonging to the categories of the screech tones and the impinging tones. It was found that three types of frequency changes of the screech tones (sawtooth,

stepwise, and intermittent ones) are realized periodically with the increasing nozzle-to-plate distance, indicating that the frequency change of the screech tone by the insertion of a small plate into the jet is associated with the self-sustained oscillation of the circular underexpanded free jet. I.S.

A92-26233#

IN-FLIGHT EXTERNAL AND INTERNAL NOISE

MEASUREMENT FOR TR-I ROCKET NOSE FAIRING

YUKIO FUKUSHIMA, KENJI TOMIOKA, TOMIHISA NAKAMURA (NASDA, Tokyo, Japan), and TORU ITOH (Kawasaki Heavy Industries, Ltd., Gifu, Japan) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 10 p. (AIAA PAPER 92-0375) Copyright

A total of three TR-I test rockets, about one-quarter size of the Japanese H-II launch vehicle, were launched in 1988 and in 1989. External and internal acoustic environments as well as vibration response of the nose fairing were measured during the ascent of each rocket. It is found that the external sound or fluctuating pressure level of the fairing is high both at lift-off and at transonic flight. However, with regard to the internal sound pressure level and the acceleration level of the fairing structure, they are high at lift-off but relatively low at transonic flight. The noise reduction (NR) and the vibration response of the structure for the rocket exhaust noise at lift-off are similar to those measured by acoustic tests in a reverberation chamber. Author

A92-30525

ACOUSTIC REDUCTION IN HIGH SUBSONIC FLOW IN A LAVAL NOZZLE

TSUNEJI TSUBASHITA, RYO FUJII, and TAKAO YOSHIKAWA (Osaka University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 88-91. In Japanese. refs

A difference method is used to calculate the sound pressure distribution, acoustic intensity, and sound power for a Laval nozzle. A computational model is presented for the Mach number distribution in the mean flow area. The sound pressure level (SPL) distribution is discussed. Y.P.Q.

A92-32502

ANALYTICAL STUDY ON PLATE EDGE NOISE. I - TRAILING EDGE NOISE CAUSED BY VORTICITY WAVES

KOJI TAKAHASHI and SHOJIRO KAJI Japan Society of Mechanical Engineers, Transactions B (ISSN 0387-5016), vol. 56, Sept. 1990, p. 2582-2589. In Japanese. refs

An analysis is performed on the trailing-edge noise which is one of the mechanisms of noise generation in flow machines. An acoustic field is treated where a semiinfinite flat plate is placed parallel to the inviscid uniform flow with incident vorticity waves convected from the upstream direction. Applying the Wiener-Hopf technique, an exact solution is derived for the sound pressure which is proportional to the amplitude of the incident vorticity wave and does not restrict frequency or velocity. The calculated acoustic field exhibits general features of the sound-pressure level (SPL) in a cardioid pattern with the constant phase surface distorted by the main flow. The relationship between flow velocity and SPL is dependent on the fifth law at low Mach numbers. The results show that such dependence does not hold at higher Mach numbers at which the radiated noise level rises progressively as the flow velocity increases. Author

A92-36008

THE RESPONSE OF ARTIFICIAL LONGITUDINAL VORTEX PAIR EMBEDDED IN THE BOUNDARY LAYER TO ACOUSTIC EXCITATION

Y. KOHAMA, Y. FUKUNISHI, and T. J. WANG (Tohoku University, Sendai, Japan) IN: Boundary layer stability and transition to turbulence; Proceedings of the Symposium, ASME and JSME Joint Fluids Engineering Conference, 1st, Portland, OR, June 23-27, 1991. New York, American Society of Mechanical Engineers, 1991,

p. 31-35. refs

Copyright

The flow condition for the onset of the secondary instability was simulated by blowing air from a streamwise slit on a flat plate. The growth of inflectional instability was investigated as a model of the secondary instability. Acoustic disturbances produced by a loudspeaker excited the secondary instability in the form of traveling disturbances around the streamwise vortex. Direct response to the disturbance frequency was observed at 290-450 Hz; below 280 Hz, the spectra peak of velocity fluctuations was constant at 345 Hz; nonlinear response was observed above 450 Hz. Results of the study indicate the possibility of the acoustic control of the secondary instability. V.L.

A92-39079

SOUND ATTENUATION BY CHAMBERS IN DUCT SYSTEMS EXAMINED BY SOUND INTENSITY MEASUREMENT AND FEM CALCULATION

HIROO YANO, SEOKJOO CHOI, TAKASHI KOGA, and HIDEKI TACHIBANA (Tokyo, University, Japan) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 583-586. refs

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A measurement technique is developed based on the two-microphone intensity method and compared to the results predicted with the finite-element method. The two-microphone intensity technique is utilized to express the transmission loss and therefore the reduction efficiency of a chamber with a 1D sound field below the cut-off frequency. The progressive and reflected sound intensities can be obtained by measuring the autospectrum density functions and the sound pressures at two points as well as the cross-spectrum density function. The measurement technique is applied to a simple expansion chamber with and without a partition and to a multiple-chamber plenum. The experimental results are found to agree with the FEM conclusions, although some assumptions regarding boundary conditions lead to discrepancies particularly in the case of the multiple-chamber plenum. C.C.S.

A92-39081

NOISE REDUCTION AND FLOW PATTERNS OF A SUPERSONIC JET DISCHARGED THROUGH A HOLE WITH AN ABRUPT ENLARGED DIFFUSER

MASAMI NAKANO (Yamagata University, Yonezawa, Japan), KYOHIRO TAJIMA, and EISUKE OUTA (Waseda University, Tokyo, Japan) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 737-740. refs

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Noise characteristics and flow behavior of a supersonic jet discharged through a hole with an abrupt enlarged short diffuser are investigated experimentally and theoretically over the range of pressure ratios up to 7. Such a modified hole is suitable for application to high pressure reducing devices of gases, such as a blowoff silencer and a low-noise valve of the multihole type and a cleaning nozzle, to improve the noise suppression. A multihole-wire gauze element as a very quiet device has been proposed. A nozzle with a relatively long expanded diffuser has been developed and tested which leads to substantial noise reduction, however, the understanding of the principle behind and the occurrence of the noise reduction is far from satisfactory. So, this study focuses on clarifying the noise reduction mechanisms and on facilitating the optimum design for attaining the high noise reduction. Author

A92-39104

TEMPORAL CHANGE OF TIMBRE OF HELICOPTER NOISE

SONOKO KUWANO and SEIICHIRO NAMBA (Osaka University, Toyonaka, Japan) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg,

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Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1177-1180. refs
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The methods of continuous judgment by selected description and by category developed by Namba and Kuwano (1988) are employed to study the impression of timbre of helicopter noise. The instantaneous impression of timbre is studied with human subjects by means of the method of continuous judgment, and the overall impression of the noises is evaluated using the semantic differential. Comparisons with fixed-wing aircraft noise shows that helicopter noise can be evaluated in the same manner as that for aircraft noise, and the use of Leq to study helicopter noise is shown to be insufficient when timbre is considered. C.C.S.

A92-39108

ACTIVE NOISE CONTROL IN A DUCT USING ACTIVE ACOUSTIC CONDUCTANCES

MASAO TAKI (Tokyo Metropolitan University, Japan) and TAKUJI MORI (Nishiwaki Laboratory, Tokyo, Japan) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1277-1280. refs
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An approach is developed based on the equivalent circuit description for active noise control in ducts using active acoustic conductances (AACs) in combination with passive silencers. The tight coupled monopole (TCM) is employed for active silencing, and its use is analyzed in the two-port duct model of sound propagation. The attenuation characteristics of the active noise-control systems are determined with specific treatment given to the effects of termination and passive silencing elements. The application of AAC to active noise control is demonstrated for a multiple AAC system and an AAC-mounted passive silencer system. The TCM is equivalent to an AAC, and AACs can be mounted at specific locations within a duct system to improve attenuation characteristics by mitigating the effects of reflections in the duct. The use of AACs in conjunction with passive silencers provides good sound attenuation as demonstrated in the two-port representation of acoustic filters. C.C.S.

A92-43160

A PERSPECTIVE ON HELICOPTER NOISE

T. MASUGO (Kumaki Polytechnic University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990. Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 300-303. In Japanese.

The noise standard for helicopters is discussed. Helicopter noise reduction is considered, and design configurations that can reduce the main rotor noise are analyzed. Y.P.Q.

A92-56055

NOISE TEST OF HIGH-SPEED COUNTERROTATION PROPELLER IN LOW-SPEED WIND TUNNEL

S. BABA, N. HASHIDATE, N. KUWANO (National Aerospace Laboratory, Chofu, Japan), K. AMANO, S. NAKAMURA, Y. WATANABE (Japan Aircraft Development Corp., Tokyo), A. KANEKO, K. SAITO (Kawasaki Heavy Industries, Ltd., Tokyo, Japan), and K. OKURA (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991. Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 246-249. In Japanese.

A noise test of a high-speed advanced counterrotation propeller was conducted in the NAL 5.5m x 6.5m low-speed wind tunnel. The propeller was run over a range of blade setting angles from 30 deg/28 deg to 30 deg/30 deg, rotor speed from 5000 to 13000 rpm and wind speed from 0 to 60 m/s. The test results confirm the following characteristics. (1) The noise level was found to have maximum peak at 3 BPF. (2) The over-all value increased with rotor speed and decreased with advance ratio. Author

A92-56074

A CALCULATION METHOD TO PREDICT HELICOPTER NOISE AND ITS VERIFICATION

KEIJI KAWACHI and YASUMICHI HASEGAWA (Tokyo, University, Japan) IN: Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-9, 1991. Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 322-325. In Japanese. refs

A numerical calculation method was developed to predict helicopter noise. This method is composed of two codes, aerodynamic code and acoustic code. The aerodynamic code utilizes the local momentum theory and the acoustic code utilizes the equation by Williams and Hawkings. The acoustic source of quadrupole is omitted. The noise from tail rotor as well as main rotor is included in the calculation. The calculated results are compared with flight tests near heliports, and the good agreement between the calculation and measurement was obtained. The effective methods to reduce the noise level of civil helicopter are also discussed. Author

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ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

A92-10058

TRAPPING OF CA(+) IONS AND OPTICAL DETECTION

SHINJI URABE, HIDETSUKA IMAJO, KAZUHIRO HAYASAKA, and MASAYOSHI WATANABE (Kansai Advanced Research Center, Kobe, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1532-L1534. refs
Copyright

A medium-sized RF ion trap is developed, and stored Ca(+) ions are optically detected. Weak fluorescence from Ca(+) ions is detected using a frequency-doubled Ti:sapphire laser and the photon-counting method. The temperature and number of stored ions are estimated from the measured spectrum of the ions and the spatial distribution of the ion cloud. Author

A92-12001

THE DOPPLER SPECTRA OF O(1D) FROM THE PHOTODISSOCIATION OF O₂, NO₂, AND N₂O

NEIL SHAFER, KENICHI TONOKURA, YUTAKA MATSUMI, SHINTARO TASAKI, and MASAHIRO KAWASAKI (Hokkaido University, Sapporo, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 95, Nov. 1, 1991, p. 6218-6223. Research supported by MOESC. refs
Copyright

The Doppler profiles of the O(1D) products from the photodissociation of O₂ at 157.6 nm and NO₂ and N₂O at 205.47 nm are detected by a resonance enhanced multiphoton ionization technique. The translation energy and angular distributions are deduced for the O(1D) atoms. Present results indicate that (1) O₂ (B ³Σ_g⁻/u) has a short dissociative lifetime when irradiated at 157.6 nm, (2) NO (2Π) photofragment from NO₂ at 205.47 nm is mostly vibrationally excited, and (3) most of the available energy is released as kinetic energy when N₂O is photodissociated at 205.47 nm. Author

A92-12985

DOPPLER PROFILES AND FINE-STRUCTURE BRANCHING RATIOS OF O(3P) FROM PHOTODISSOCIATION OF CARBON DIOXIDE AT 157 NM

YUTAKA MATSUMI, NEIL SHAFER, KENICHI TONOKURA, MASAHIRO KAWASAKI (Hokkaido University, Sapporo, Japan), YU-LIN HUANG, and ROBERT J. GORDON (Illinois, University, Chicago) Journal of Chemical Physics (ISSN 0021-9606), vol. 95, Nov. 15, 1991, p. 7311-7316. Research supported by MOESC

and Petroleum Research Fund. refs
(Contract DE-FG02-88ER-13827)
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The $O(2p\ 3P_j)$ ($j = 2, 1$, and 0) fragments produced in the 157 nm photodissociation of CO_2 were detected by resonance-enhanced multiphoton ionization in a molecular beam. The Doppler profiles and fine-structure branching ratios were measured for the oxygen-atom photofragment in the $3P_j$ states. The Doppler profiles were analyzed to give an anisotropy parameter of $\beta = 2.0 \pm 0.2$ and an internal energy equivalent to 3.9 ± 0.3 vibrational quanta of CO . The fine-structure populations were found to be 0.70 ± 0.05 , 0.16 ± 0.03 , and 0.14 ± 0.03 for $j = 2, 1$, and 0 , respectively. A mechanism is proposed in which complex on the $1B_2$ surface undergoes intersystem crossing to the $3B_2$ surface. A phase-space model with a constraint on the impact parameter is shown to be consistent with the observed energy release. Author

A92-17493

A THEORETICAL STUDY ON THE DIPOLE MOMENT OF N_2O AND THE WEAKLY BOUND COMPLEXES FORMED BY N_2O

K. MOGI, T. KOMINE (Nagoya University, Japan), and K. HIRAO (Nagoya University; Institute for Molecular Science, Okazaki, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 95, Dec. 15, 1991, p. 8999-9008. Research supported by MOESC. refs

Copyright

The structures and stability of several weakly bound complexes formed by N_2O were investigated. It is shown that the N_2O dipole moment is very sensitive to two bond lengths and to the electron correlation. O.G.

A92-17937

NON-REACTIVE VIBRATIONAL TRANSITION PROCESSES OF H_2 MOLECULE BY H ATOM IMPACT IN THE ENERGY RANGE BELOW THE DISSOCIATION THRESHOLD

KUNIZO ONDA, MASAHIRO IWAI, and TAKASHI WADA (Institute of Space and Astronautical Science, Sagami-hara, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Oct. 1991, p. 3327-3339. refs

Copyright

Vibrational transition processes of H_2 molecule in the electronic ground state by H atom impact are examined using close coupling equations under the rotational infinite-order-sudden approximation. It is found that a dip part of the vibrational matrix elements induces vibrational transitions and a positive part has little effect on these transitions. O.G.

A92-24643

MECHANISM OF THERMAL ELECTRON ATTACHMENT TO SO_2

HIROSHI SHIMAMORI and YOSHITSUGU NAKATANI (Fukui Institute of Technology, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, Feb. 1, 1992, p. 1967-1974. Research supported by MOESC. refs

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The pulse radiolysis microwave cavity method has been used to ascertain the thermal electron attachment rate constants of SO_2 in pure SO_2 and SO_2 -M mixtures, in the 0.4-700 torr pressure and 253-343 K temperature ranges. A new attachment mechanism is proposed in which two different, two-step, three-body processes occur simultaneously; each involves different compound-negative-ion states of the $SO_2(-)$ ion. Lower limits of the autoionization lifetimes are estimated for the intermediate ions involved in the two processes. O.C.

A92-28909

FOURIER TRANSFORM INFRARED SPECTROSCOPY OF THE BH_3 NU SUB 3 BAND

KENTAROU KAWAGUCHI (Nobeyama Radio Observatory, Minamimaki, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, March 1, 1992, p. 3411-3415. refs

Copyright

The gas-phase infrared spectrum of the BH_3 nu sub 3 band was observed in the 2600/cm region by a Fourier transform infrared spectrometer. The borane molecule was produced with a discharge in a B_2H_6 and He mixture. The spectral pattern was consistent with the D sub 3h structure of borane. The observed spectrum between 2450-2730/cm was analyzed to determine band origins, rotational constants, and centrifugal distortion constants. The nu sub 3 band origins of (B-11) H_3 and (B-10) H_3 were 2601.5743(15) and 2615.7935 (21)/cm, respectively, with one standard deviation in parentheses. The B-H bond length was determined for the first time experimentally to be $r_{sub\ 0} = 1.190\ 01\ (1)\ \text{\AA}$ from the ground state rotational constant B sub 0. Author

A92-28916

IMPROVED RATE THEORIES OF CHEMICAL REACTIONS

AKIO MORITA (Tokyo, University, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, March 1, 1992, p. 3678-3687. refs

(Contract MOESC-02245101)

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A macroscopic theory is advanced that permits the interpretation of the preexponential factor in terms of the behavior of the reactant potential and the barrier height. The technique is an improved version of the treatment in Kramer's theory in which the Brownian motion near the bottom of the potential minimum is closely examined. A modified Smoluchowski equation is presented that is not velocity-dependent, and the reaction coefficient is set equal to the flux/concentration of the reactant. A lower limit for the friction value is developed by computerized symbolic manipulation that corresponds to the critical damping motion of a harmonic damped oscillator. The present method is shown to accommodate the Kramer's turnover for the case of the steep decline of the potential, whereas the Boltzmann transport equation with a recently developed collision term does not lead to Kramer's turnover. C.C.S.

A92-30030

THE MICROWAVE SPECTRUM OF THE CH_2N RADICAL IN THE X 2B₂ GROUND ELECTRONIC STATE

SATOSHI YAMAMOTO and SHUJI SAITO (Nagoya University, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, March 15, 1992, p. 4157-4162. Research supported by Morino Science Foundation. refs

(Contract MOESC-63632514; MOESC-63540192;

MOESC-01632513; MOESC-03640426)

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The rotational spectral lines of the CH_2N radical in the 2B₂ ground electronic state are detected by using a source-modulation microwave spectrometer. The radical is produced in a glow discharge plasma of a gaseous mixture of CH_4 and N_2 . In total, 181 fine and hyperfine components of the rotational transitions with $N = 1-0$ to $N = 5-4$ are observed in the frequency region between 73 and 370 GHz. They are analyzed to obtain the molecular constants including hyperfine interaction constants for the H and N nuclei. The molecular structure and the spin density of CH_2N are determined from the obtained molecular constants. Author

A92-32903

PHOTOABSORPTION, PHOTOIONIZATION, AND NEUTRAL DISSOCIATION CROSS SECTIONS OF DIMETHYL ETHER AND ETHYL METHYL ETHER IN THE EXTREME-ULTRAVIOLET RANGE

KOSEI KAMETA, MASATOSHI UKAI, TETSU KAMOSAKI, KYOJI SHINSAKA, NORIYUKI KOUCHI, YOSHIHIKO HATANNO (Tokyo Institute of Technology, Japan), and KENICHIRO TANAKA (National Laboratory for High Energy Physics, Tsukuba, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, April 1, 1992, p. 4911-4917. Research supported by MOESC. refs

Copyright

A92-33959

STATE-TO-STATE CROSS SECTION OF ROTATIONAL TRANSITION CAUSED BY DIPOLE-QUADRUPOLE INTERACTION BETWEEN NH₃ AND NONPOLAR MOLECULES
YOSHIHIKO UEMATSU, MAKI TACHIKAWA, YOSHIHITO TANAKA, FUSAKAZU MATSUSHIMA, and TADAO SHIMIZU (Tokyo, University, Japan) *Journal of Chemical Physics* (ISSN 0021-9606), vol. 96, April 15, 1992, p. 5797-5800. refs
Copyright

Rotational transitions in NH₃ induced by the dipole-quadrupole collisional interaction are studied by use of the supersonic molecular-beam technique and double-resonance spectroscopy. The measured state-to-state cross section agrees well with the cross section calculated nonempirically based on the Anderson-Tsao-Curnutte theory, which depends only on the dipole-matrix element between the initial and final states of NH₃. It is deduced that the state-to-all-states cross section is independent of the molecular quantum states. Author

A92-37467

ROVIBRATIONAL DISTRIBUTIONS OF CH(A 2DELTA) PRODUCED IN ENERGY-TRANSFER REACTIONS FROM AR(3P2), KR(3P2), AND Xe(3P2) ATOMS TO C₂H₅ RADICAL
MASAHARU TSUJI, HIROYUKI KOUNO, HIROKI UJITA, and YUKIO NISHIMURA (Kyushu University, Kasuga, Japan) *Journal of Chemical Physics* (ISSN 0021-9606), vol. 96, no. 9, May 1, 1992, p. 6746-6751. Research supported by MOESC, Asahi Glass Foundation, Ito Science Foundation, and Shimadzu Science Foundation. refs
Copyright

A92-42396

AN ATOMIC BEAM COLLIMATOR FOR CS BEAM FREQUENCY STANDARDS
KENJI HISADOME and MASAMI KIHARA (NTT, Transmission Systems Laboratories, Yokosuka, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1232-1235. refs
Copyright

An improved beam collimator theory is presented which takes into account collision processes. The theory can describe general cases including the case where the mean free path length is comparable to the collimator length. Systematic experiments were carried out using atomic beam collimators of three lengths (17, 34, and 50 mm), demonstrating the effect of the collimator length and the oven temperature on the atomic beam characteristics. The experimentally obtained beam profiles and peak beam intensities are compared with calculated values, showing good agreement. I.S.

A92-45468

FORMATION OF THE CHELATE BONDS IN THE CLUSTER O₂(-)(CO₂)_N, CO₃(-)(CO₂)_N AND NO₂(-)(CO₂)_N
KENZO HIRAOKA (Yamanashi University, Kofu, Japan) and SHINICHI YAMABE (Nara University of Education, Japan) *Journal of Chemical Physics* (ISSN 0021-9606), vol. 97, no. 1, July 1, 1992, p. 643-650. Research supported by MOESC and Morino Foundation for Molecular Science. refs
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A pulsed electron beam high-pressure mass spectrometer is used to examine the equilibria of gas-phase clustering reactions of O₂(-), CO₃(-), and NO₂(-) with CO₂. Thermochemical stabilities of the clusters O₂(-)(CO₂)_n, CO₃(-)(CO₂)_n, and NO₂(-)(CO₂)_n with $n = 1-8$ are determined. For O₂(-)(CO₂)_n, irregular decreases in the values of $-\Delta H \exp 0(n-1, n)$ were observed between $N = 1$ and 2, and $N = 3$ and 4. These gaps indicate that the bond with covalent character is formed through the charge transfer (CT) O₂(-) yields CO₂, and the CT complex of O₂COO(-) accommodates two CO₂ molecules preferably. The $-\Delta H \exp 0(N-1, n)$ values of both CO₃(-)(CO₂)_n and NO₂(-)(CO₂)_n clusters show an irregular decrease between $n = 4$ and 5. This suggests the formation of shells, OCO₂(-)(CO₂)₄ and NO₂(-)(CO₂)₂. Ab initio optimized

geometries of these clusters are found to be comprised of bridge (i.e., chelate) intermolecular bonds. P.D.

A92-49966

KINETIC-ENERGY RELEASE IN THE DISSOCIATIVE DOUBLE PHOTOIONIZATION OF OCS
TOSHIO MASUOKA (Osaka City University, Japan), INOSUKE KOYANO (Himeji Institute of Technology, Japan), and NORIO SAITO (Electrotechnical Laboratory, Tsukuba, Japan) *Journal of Chemical Physics* (ISSN 0021-9606), vol. 97, no. 4, Aug. 15, 1992, p. 2392-2399. Research supported by Institute for Molecular Science. refs
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Synchrotron radiation and the photoion-photoion coincidence (PIPICO) spectra were used to investigate the kinetic-energy release (KER) distributions of fragment ions produced in the dissociative double photoionization of the OCS molecule over the energy region of the valence orbitals. Analyses of PIPICO spectra yield new information on the dissociation dynamics of the OCS(2+) ion, including the KER distributions, their dependence on the excitation photon energy, and the electronic states of the fragments produced at the dissociation thresholds for the major dissociation channels of OCS(2+). From the measurements of the average KER as a function of the excitation photon energy, it is concluded that, in contrast to previous reports, the fragment ions are produced in their excited (rather than ground) states at the respective dissociation thresholds for most of the dissociation channels examined. I.S.

A92-54651

AUTOIONIZING-RESONANCE ENHANCED PREFERENTIAL PHOTODISSOCIATION OF CO₂ IN SUPEREXCITED STATES
MASATOSHI UKAI, KOSEI KAMETA, NORIYUKI KOUCHI, KAZUNORI NAGANO, YOSHIHIKO HATANO (Tokyo Institute of Technology, Japan), and KENICHIRO TANAKA (National Laboratory for High Energy Physics, Tsukuba, Japan) *Journal of Chemical Physics* (ISSN 0021-9606), vol. 97, no. 5, Sept. 1, 1992, p. 2835-2842. Research supported by MOESC. refs
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The paper presents a competitive-decay feature of superexcited states into the resonance enhanced autoionization and neutral dissociation, especially at the thresholds of ionic excited states. A drastic step-down decrease in a fluorescence excitation spectrum in the vacuum UV region at the thresholds is ascribed to a dramatic density dilution of the superexcited states into the continuum. C.A.B.

A92-56356

ROTATIONAL ANALYSIS OF V = 1 LEVEL OF N = 8-10 RYDBERG STATES OF CO BY TRIPLE RESONANT MULTIPHOTON SPECTROSCOPY
TAKAYUKI EBATA, NOBUKI HOSOI, and MITSUO ITO (Tohoku University, Sendai, Japan) *Journal of Chemical Physics* (ISSN 0021-9606), vol. 97, no. 6, Sept. 15, 1992, p. 3920-3930. refs
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Results of a detailed analysis of the rotational structure of high Rydberg states of CO converging to the ionic state are presented. These states were pumped from the 3s(σ)B 1(σ +) state using triple resonant multiphoton excitation. The observed states were $n = 8-10$ of the s-, p-, d-, and f-Rydberg states in the vibrational levels with $v = 1$. Mixing between 9s and 8f, and 10s and 9f states was observed in spite of the different symmetry of the orbital and large difference of angular momentum. Among the Rydberg series, a line broadening was observed for the nd(σ)- and np-Rydberg states. The line broadening is attributed to the short lifetime due to the large predissociation rate. It is concluded that these states may play an important role in the photodissociation process in the high energy region. C.A.B.

A92-56370

DOPPLER-FREE ZEEMAN SPECTROSCOPY OF THE NO₂ 593.3 NM BAND

MASAAKI BABA (Kyoto University, Japan), HISAKI YAMADA, and KIYOSHI NISHIZAWA (Kobe University, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 97, no. 6, Sept. 15, 1992, p. 4569, 4570. Research supported by MOESC. refs Copyright

Doppler-free Zeeman spectroscopy in a collimated molecular beam is studied in order to investigate the rotational and spin structure of the NO₂ 593.3 nm band on the basis of the magnetic properties. The Zeeman pattern of the excitation spectrum was found to strongly depend on the rotational and spin levels. The number of the split lines depended on N, and the splitting on K and the intensity distribution was different between the F₁ and F₂ levels. Such Zeeman patterns of the high-resolution spectrum facilitate the assigning of the rotational lines which are irregularly shifted by perturbations. C.A.B.

N92-14813# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

A SEARCH FOR CHARGED HIGGS BOSONS AT TRISTAN

I. ADACHI (Nagoya Univ. (Japan).), H. AIHARA (Tokyo Univ. (Japan).), and M. DOSER (National Lab. for High Energy Physics, Ibaraki, Japan) May 1990 16 p (DE91-767869; INS-813) Avail: CASI HC A03/MF A01

We searched for pair production of charged Higgs bosons via proton antiproton annihilation, using data (23.3pb(exp -1)) collected by the TOPAZ detector in the energy range $\sqrt{s} = 52.0$ similar to 61.4 GeV. We observed no evidence for charged Higgs pair production and extended the excluded region in the M sub H + or - BR(hadron) plane. The 95 pct. CL lower mass limit is the most stringent for BR(hadron) = 0.6, giving M(sub H)+ or - greater than 22 GeV. DOE

N92-15710# Japan Atomic Energy Research Inst., Ibaraki.

MEASUREMENT OF FORMATION CROSS SECTIONS OF SHORT-LIVED NUCLEI BY 14 MEV NEUTRONS: MG, SI, S, CL, CR, ZN, GA, Y, IN

KIYOSHI KAWADE (Nagoya Univ. (Japan).), HIROSHI YAMAMOTO (Nagoya Univ. (Japan).), TAKASHI YAMADA (Nagoya Univ. (Japan).), TOSHIO KATOH (Nagoya Univ. (Japan).), TOSHIYUKI IIDA (Osaka Univ. (Japan).), and AKITO TAKAHASHI (Osaka Univ., Japan) Oct. 1990 76 p (DE91-003000; JAERI-M-90-171; NEANDC(J)-154/U; INDC(JPN)-140/L) Avail: CASI HC A05/MF A01

Sixteen neutron activation cross sections for (n,2n), (n,p), (n,n(prime)p), (n,t) and (n, alpha) reactions producing short-lived nuclei with half-lives between 0.5 and 20 m have been measured in the energy range of 13.4 to 14.9 MeV for Mg, Si, S, Cl, Cr, Zn, Ga, Y and In. Five half-lives of short-lived nuclei produced by 14 MeV or thermal neutron bombardments were measured with Ge detectors for Cu-66, Zr-89m, Mo-91m, Nb-97m, and Rh-104m in the spectrum multi-scaling mode. DOE

N92-15716# Japan Atomic Energy Research Inst., Tokyo. NEW KINETIC THEORY FOR NON-EQUILIBRIUM DENSE GASES

YUKICHI TAJI (Japan Atomic Energy Research Inst., Tokai.) Mar. 1991 70 p (DE91-508204; JAERI-M-91-031) Avail: CASI HC A04/MF A01

In the usual kinetic theory of gases it has been believed that any states of gases are describable if the Liouville equation is suitably approximated because the equation describes every mechanical state of gases. Here, however, the Liouville equation, which is certainly deterministic in phase space, is clarified to be able to treat only isotropic equilibrium dilute gases in mu-space, through the discussion of which a new kinetic theory is proposed to treat anisotropic nonequilibrium dense gases. These matters are reported in Part 1. In Part 2, an extended Boltzmann equation is derived by applying the theory to the case of nonequilibrium monoatomic molecular dense gases in which the effect of triple collisions is considered so anisotropic momentum transfer in collisions can be treated. In Part 3, the case of nonequilibrium gases of dumbbell-shaped molecules is treated and moment equations of angular momentum transfer between rotating

molecules are shown to be expressed in the same form as Maxwell's equations; this corresponds to the growth theory of thunder. DOE

N92-15717# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

METASTABLE EXOTIC ATOMS OF EXTREME QUANTUM NUMBERS

TOSHIMITSU YAMAZAKI Apr. 1991 18 p (DE91-508223; INS-868) Avail: CASI HC A03/MF A01

New aspects of exotic atoms and nuclei which exhibit metastability (narrow width) are discussed. They are characterized by halo structure that protects the exotic particle from being absorbed promptly. Two examples are described: (1) deeply bound pionic atoms; and (2) metastable exotic helium atoms. DOE

N92-15731# Japan Atomic Energy Research Inst., Tokai.

MEASUREMENT OF DOUBLE-DIFFERENTIAL NEUTRON EMISSION CROSS SECTIONS OF U-238, TH-232 AND C-12 FOR 18 MEV NEUTRONS

MAMORU BABA (Japan Automobile Research Inst., Tokyo.), SHIGEO MATSUYAMA (Japan Automobile Research Inst., Tokyo.), TAKUYA ITO (Japan Automobile Research Inst., Tokyo.), NOBUO ITO (Japan Automobile Research Inst., Tokyo.), KAZUTO MAEDA (Japan Automobile Research Inst., Tokyo.), and NAOHIRO HIRAKAWA (Tohoku Univ., Sendai, Japan) Apr. 1991 37 p (DE91-790974; JAERI-M-91-059) Avail: CASI HC A03/MF A01

Double-differential neutron emission cross sections of U-238, Th-232, C-12 have been measured for 18-MeV incident neutrons using the neutron time-of-flight technique and Tohoku University 4.5MV Dynamitron accelerator as a pulsed neutron generator. In the experiment, energy resolution of the spectrometer was improved by employing a newly developed post-acceleration beam-chopper and by adjustment of timing property of the neutron detector. Measurements were made at laboratory angles between 30- and 145- deg., and data were obtained for secondary neutrons between 0.8 and 18 MeV. In the data processing, care was taken with the data correction for the effects of parasitic neutrons associated with primary neutrons; the correction proved to be of special importance in the present measurement. We compared the data obtained in the present experiment with the evaluated data, JENDL-3 and ENDF/B-IV (B-V for C-12), and discussed the origin of the discrepancies. The anisotropy observed for secondary neutrons from U-238 and Th-232 was found to be reproduced by Kalbach-Mann systematics on the assumption of isotropy of fission neutrons. The experimental results for C-12 showed marked discrepancies concerning the scattering cross sections and neutron spectrum in the continuum region. DOE

N92-15732# Japan Atomic Energy Research Inst., Tokyo.

DEVELOPMENT OF A NEGATIVE ION MEASUREMENT PROBE AND INITIAL RESULTS OF EXPERIMENTS

KAZUHIRO WATANABE, TAKASHI INOUE, HIROAKI KOJIMA, YASUHIRO MATSUDA, and YOSHIKAZU OKUMURA Dec. 1990 22 p In JAPANESE; ENGLISH summary Prepared in cooperation with Japan Atomic Energy Research Inst., Ibaraki (DE91-780244; JAERI-M-90-219) Avail: CASI HC A03/MF A01

A negative ion probe for the measurement of extractable negative ion currents in a plasma has been developed and tested. This probe was designed in accordance with the single aperture of the negative ion source accelerator developed at JAERI. The probe consists of a plasma electrode, an extraction electron in which a pair of permanent magnets is inserted for the electron suppression, and an ion collective cup. At first, we confirmed the accuracy of the measurement by comparing the measured value with the H(-) current actually extracted in a small negative ion source. Then the negative ion current in the ECR ion source was measured. After these experiments, it was confirmed that the probe is effective for comparing the extractable negative ion current in various ion sources and for the measurement of spatial distribution of negative ions in a plasma. DOE

72 ATOMIC AND MOLECULAR PHYSICS

N92-16718# Japan Atomic Energy Research Inst., Ibaraki.
X RAY ABSORPTION COEFFICIENTS OF THE ELEMENTS (LI TO BI, U

SATOSHI SASAKI Nov. 1990 146 p
(DE91-780316; KEK-90-16) Avail: CASI HC A07/MF A02

The atomic absorption coefficient, $\mu(\text{sub } a)$, and the mass absorption coefficient, μ/ρ , have been calculated for the elements Li to Bi and U, based on both photoelectric and scattering effects. Tables include the $\mu(\text{sub } a)$ and μ/ρ values: (1) at 0.01 Å intervals in the wavelength range from 0.1 to 2.89 Å; and (2) at 0.0001 Å intervals in the neighborhood of the K, L(sub 1), L(sub 2), and L(sub 3) absorption edges. DOE

N92-16719# Japan Atomic Energy Research Inst., Ibaraki.
ANNOTATED REFERENCES ON SHIELDING EXPERIMENT AND CALCULATION OF HIGH ENERGY PARTICLES

H. HIRAYAMA, S. BAN, and T. NAKAMURA Dec. 1990 48 p
(DE91-780317; KEK-90-18) Avail: CASI HC A03/MF A01

The literature on shielding experiment and calculation of high energy particles above 20 MeV has been surveyed. The survey covers thirteen journals, from 1965 up to 1989. For each paper, applicable information is listed on type and energy of the projectile, the accelerator used, composition and thickness of the target and shielding materials, shielding geometry, the experimental and calculational methods, and the quantities obtained. The references on shielding experiment and on shielding calculation are accessed through two indices which list the projectile-target and shielding material combination, shielding geometry, and the projectile energy range. The literature on neutron, photon, and hadron production from thick target bombarded by charged particles has been surveyed mainly from 1984 as a complement of the previous work. DOE

N92-16727# National Inst. for Fusion Science, Nagoya (Japan).
EQUILIBRIUM CHARGE FRACTION OF IONS OF $Z=4-92$ (0.02-6 MEV/U) AND $Z=4-20$ (UP TO 40 MEV/U) EMERGING FROM A CARBON FOIL

KUNIHITO SHIMA (Tsukuba Univ., Ibaraki (Japan).), NORIYOSHI KUNO (Tsukuba Univ., Ibaraki (Japan).), MIKIO YAMANOUCHI (Tsukuba Univ., Ibaraki, Japan), and HIROYUKI TAWARA Jan. 1991 85 p
(DE91-790860; NIFS-DATA-10) Avail: CASI HC A05/MF A01

Based on recent finding that the variation of charge fractions, mean charges and charge distribution widths with ion energy (E), and projectile atomic number (Z) are strongly dependent on the shell structure of ions, systematic reanalysis of the charge distributions of ions were performed. Graphs obtained in this manner are presented for equilibrium charge fractions of ions emerging from a carbon foil as a function of E ranging from 0.02 to 6 MeV/u. Each graph pertains to one ion species from $Z = 4$ to 83 and $Z = 92$. Tables of the mean charges and charge distribution widths are also given for each ion species in the same range of Z and E. For fast ions of $Z = 4$ to 20 up to 40 MeV/u, charge fractions of fully stripped ions, H-like ions, and He-like ions are tabulated. DOE

N92-16738# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

SUPERFICIAL VIOLATION OF THE PAULI PRINCIPLE DUE TO THE POSSIBLE SUBSTRUCTURE OF ELECTRONS

KEIICHI AKAMA (Saitama Univ., Urawa, Japan), HIDEZUMI TERAZAWA, and MASAKI YASUE Apr. 1991 12 p
(DE91-522323; INS-874) Avail: CASI HC A03/MF A01

Superficial violation of the Pauli principle due to the possible substructure of electrons is discussed in composite models of quarks and leptons. The ratio of the Pauli forbidden atomic transition to the allowed one is estimated to be of order $10(\text{exp } -50)$ approximately = $10(\text{exp } -44)$ for heavy atoms if the size of the electron is of order $10(\text{exp } -17)$ cm. DOE

N92-16739# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

HIGH-RESOLUTION SPECTROSCOPY OF DEEPLY-BOUND PIONIC ATOMS IN HEAVY NUCLEI BY PION-TRANSFER REACTIONS OF INVERSE KINEMATICS USING THE GSI COOLER RING ESR

TOSHIMITSU YAMAZAKI Feb. 1991 10 p
(DE91-522438; INS-866) Avail: CASI HC A02/MF A01

Many studies published in the past are reviewed first in relation to high-resolution spectroscopy of deeply-bound pionic atoms in heavy nuclei. The report then describes a procedure for applying the method of inverse kinematics to the case of (d, He-3) reactions. The (d, He-3) reaction in inverse kinematics is feasible from practical viewpoints. Thus a discussion is made of the inverse kinematics in which a heavy-ion beam (Pb-208 for instance) with a projectile kinetic energy hits a deuteron target and ejected recoil He-3 nuclei are measured in the forward direction. The recoil momentum is calculated as a function of the Q value. Analysis shows that the recoil spectroscopy with inverse kinematics can be applied to the case of (d, He-3) reaction, which will yield a very high mass resolution. The experimental setup for use in the first stage is then outlined, and a simple detector configuration free of magnetic field is discussed. These investigations demonstrate that the (d, He-3) reaction in inverse kinematics provides a promising tool for obtaining high-resolution spectra of deeply-bound pionic atoms. DOE

N92-23714# Los Alamos National Lab., NM.

FROM GROUND STATE TO FISSION FRAGMENTS: A COMPLEX, MULTI-DIMENSIONAL MULTI-PATH PROBLEM

P. MOELLER (Japan Atomic Energy Research Inst., Naka.), J. R. NIX (Los Alamos National Lab., NM.), and W. J. SWIATECKI (California Univ., Berkeley. Lawrence Berkeley Lab.) 1992 61 p Presented at the Specialists' Meeting on Physics and Engineering of Fission, Osaka, Japan, 7 Jan. 1991 (Contract W-7405-ENG-36)

(DE92-008488; LA-UR-92-578; CONF-920192-1) Avail: CASI HC A04/MF A01

Experimental results on the fission properties of nuclei close to Fm-264 show sudden and large changes with a change of only one or two neutrons or protons. The nucleus Fm-258, for instance, undergoes symmetric fission with a half-life of about 0.4 ms and a kinetic-energy distribution peaked at about 235 MeV whereas Fm-256 undergoes asymmetric fission with a half-life of about 3 h and a kinetic-energy distribution peaked at about 200 MeV. Qualitatively, these sudden changes have been postulated to be due to the emergence of fragment shells in symmetric-fission products close to Sn-132. Here we present a quantitative calculation that shows where high-kinetic-energy symmetric fusion occurs and why it is associated with a sudden and large decrease in fission half-lives. We base our study on calculations of potential-energy surfaces in the macroscopic-microscopic model and a semi-empirical model for the nuclear inertia. We use the three-quadratic-surface parameterization to generate the shapes for which the potential-energy surfaces are calculated. The use of this parameterization and the use of the finite-range macroscopic model allows for the study of two touching spheres and similar shapes. Since these shapes are thought to correspond to the scission shapes for the high-kinetic-energy events, it is of crucial importance that a continuous sequence of shapes leading from the nuclear ground state to these configurations can be studied within the framework of the model. We present the results of the calculations in terms of potential-energy surfaces and fission half-lives for heavy even nuclei. The surfaces are displayed in the form of contour diagrams as functions of two moments of the shape. They clearly show the appearance of a second fission valley, which leads to scission configurations close to two touching spheres, for fissioning systems in the vicinity of Fm-264. DOE

N92-25950# National Inst. for Fusion Science, Nagoya (Japan).
PARTIAL AND TOTAL ELECTRONIC STOPPING CROSS SECTIONS OF ATOMS FOR A SINGLY CHARGED HELIUM ION, PART 2

T. KANEKO, M. NISHIKORI, and N. YAMATO Aug. 1991 52 p
(DE92-768074; NIFS-DATA-13-PT-2) Avail: CASI HC A04/MF A01

Partial and total electronic stopping cross sections of atoms with Z (55 less than or equal to Z less than or equal to 92) for a $\text{He}(+)$ ion are tabulated as the second part of results on the basis of the wave-packet theory. The results are extended from earlier work. DOE

N92-30500# National Inst. for Fusion Science, Nagoya (Japan).
EFFECTS OF FAST IONS AND AN EXTERNAL INDUCTIVE ELECTRIC FIELD ON THE NEOCLASSICAL PARALLEL FLOW, CURRENT, AND ROTATION IN GENERAL TOROIDAL SYSTEMS

NORIYOSHI NAKAJIMA and MASAO OKAMOTO May 1992 25 p

(ISSN 0915-633X)

(NIFS-150) Avail: CASI HC A03/MF A01

Effects of external momentum sources, i.e., fast ions produced by the neutral beam injection and an external inductive electric field, on the neoclassical ion parallel flow, current, and rotation are analytically investigated for a simple plasma in general toroidal systems. It is shown that the contribution of the external sources to the ion parallel flow becomes large as the collision frequency of thermal ions increases because of the momentum conservation of Coulomb collisions and sharply decreasing viscosity coefficients with collision frequency. As a result, the beam-driven parallel flow of thermal ions becomes comparable to that of electrons in the Pfirsch-Schluter collisionality regime, whereas in the $1/\nu$ or banana regime it is smaller than that of electrons by the order of sq. root of $(m_{\text{sub } 3}/m_{\text{sub } 1})$ ($m_{\text{sub } 3}$ and $m_{\text{sub } 1}$ are electron and ion masses). This beam-driven ion parallel flow can not produce a large beam-driven current because of the cancellation with electron parallel flow, but produces a large toroidal rotation of ions. As both electrons and ions approach the Pfirsch-Schluter collisionality regime, the contribution of thermodynamical forces becomes negligibly small and the large toroidal rotation of ions is predominated by the beam-driven component in the non-axisymmetric configuration with large helical ripples. Author

N92-30501# National Inst. for Fusion Science, Nagoya (Japan).
NEGATIVE ION EXTRACTION CHARACTERISTICS OF A LARGE NEGATIVE ION SOURCE WITH DOUBLE-MAGNETIC FILTER CONFIGURATION

Y. TAKEIRI, A. ANDO, O. KANEKO, Y. OKA, and T. KURODA May 1992 32 p

(ISSN 0915-633X)

(NIFS-151) Avail: CASI HC A03/MF A01

A multi-ampere hydrogen negative ion source with a large extraction area of 25 cm x 25 cm was developed. This negative ion source is a volume-production-type bucket ion source which is operated with double-magnetic filter configuration. In this configuration, the fast electrons, which produce the vibrationally excited molecules, are trapped near the chamber wall by the cusp field, which is the first magnetic filter. In the central region of the arc chamber, there exist only the thermal electrons with low temperature. As a result, the negative ions are produced in the central region by dissociative attachment. A rod magnetic filter in front of the plasma grid, which is the second magnetic filter, is utilized for reducing the population of the electrons in the vicinity of the plasma grid, which are extracted together with the negative ions. By this structure the extracted electron current can be controlled independently of the $\text{H}(-)$ ion current. So far, a 1.4A of $\text{H}(-)$ ion current was obtained with the energy of 34 keV. Negative ion extraction characteristics of this ion source, such as the arc power dependence and the gas pressure dependence, are presented. Author

N92-30510# National Inst. for Fusion Science, Nagoya (Japan).
RAPID CHANGE OF HYDROGEN NEUTRAL ENERGY DISTRIBUTION AT L/H-TRANSITION IN JFT-2M H-MODE

Y. MIURA (Japan Atomic Energy Research Inst., Tokai.), F. OKANO (Japan Atomic Energy Research Inst., Tokai.), N. SUZUKI (Japan

Atomic Energy Research Inst., Tokai.), M. MORI (Japan Atomic Energy Research Inst., Tokai.), K. HOSHINO (Japan Atomic Energy Research Inst., Tokai.), H. MAEDA (Japan Atomic Energy Research Inst., Tokai.), T. TAKIZUKA (Japan Atomic Energy Research Inst., Tokai.), SANA-E. ITOH, and K. ITOH Feb. 1992 21 p Submitted for publication

(ISSN 0915-633X)

(NIFS-134) Avail: CASI HC A03/MF A01

Rapid changes of the main ion energy distribution at transitions from L to H, H to L and during edge localized modes (ELMs) are studied with the time of flight neutral measurement on the JFT-2M tokamak. At the L to H transition, 200-400 microns prior to the start of H (sub alpha) drop, an increase of the high energy outflux above an energy of 200eV is observed. An energy of more than 200eV for hydrogen corresponds to the collisionless condition $\epsilon_{\text{sub } 1}$ less than 1 just inside the separatrix. The change of the energy distribution precedes that of the H (sub alpha) signal and is also found for ELMs and the H to L transition. Author

N92-30572# National Inst. for Fusion Science, Nagoya (Japan).
PRODUCTION OF NEGATIVE HYDROGEN IONS IN A LARGE MULTICUSP ION SOURCE WITH DOUBLE-MAGNETIC FILTER CONFIGURATION

A. ANDO, Y. TAKEIRI, O. KANEKO, Y. OKA, M. WADA, and T. KURODA May 1992 41 p

(ISSN 0915-633X)

(NIFS-149; AD-B166253L) Avail: CASI HC A03/MF A01

The production of the negative hydrogen ions in a large multicusp ion source has been investigated in a double-magnetic filter (DMF) configuration. In the DMF configuration, the energetic electrons are trapped by the mirror of a magnetic multicusp field, and only the thermal electrons are present in the center of the arc chamber. A large amount of $\text{H}(-)$ ions of more than 1×10^{12} (exp 12) cm(exp -3) are produced in the center region. The electron current extracted with the $\text{H}(-)$ ions can be suppressed by a magnetic filter field in front of a plasma grid without affecting the $\text{H}(-)$ ion current. The experimental data obtained in the DMF configuration are compared with those obtained in a single-magnetic filter (SMF) configuration. In the SMF configuration, the energetic electrons are present in the center region, and the magnetic filter in front of a plasma grid reduces the electron density and temperature, which results in the reduction of the $\text{H}(-)$ ion current as well as the electron current. The extracted electron current and the optimum gas pressure for the $\text{H}(-)$ ion current are lower in the DMF configuration than those in the SMF configuration. Author

N92-30967# National Inst. for Fusion Science, Nagoya (Japan).
LINE-EMISSION CROSS SECTIONS FOR THE CHARGE-EXCHANGE REACTION BETWEEN FULLY STRIPPED CARBON AND ATOMIC HYDROGEN IN TOKAMAK PLASMA

K. IIDA and T. KATO Jan. 1992 22 p Submitted for publication

(ISSN 0915-633X)

(NIFS-129) Avail: CASI HC A03/MF A01

Line-emission cross sections of the charge-exchange reaction between fully stripped carbon and atomic hydrogen are measured in the energy range of 18-38 keV/amu in tokamak plasmas. The energy dependence of the emission cross sections for the transition of $\Delta n = 8-7$ and $\Delta n = 7-6$ and their ratios are compared with theoretical calculations. Author

N92-30990# National Inst. for Fusion Science, Nagoya (Japan).
STUDY OF $\text{Au}(-)$ PRODUCTION IN A PLASMA-SPUTTER TYPE NEGATIVE ION SOURCE Ph.D. Thesis - Nagoya Univ.

YUSHIROU OKABE Oct. 1991 76 p Sponsored in part by the Ministry of Education, Science and Culture, Japan

(ISSN 0915-633X)

(NIFS-115) Avail: CASI HC A05/MF A01

A negative ion source of plasma-sputter type has been constructed for the purpose of studying physical processes which take place in the ion source. Negative ions of gold are produced on the gold target which is immersed in an argon discharge plasma

and biased negatively with respect to the plasma. The work function of the target surface was lowered by the deposition of Cs on the target. An in-situ method has been developed to determine the work function of the target surface in the ion source under discharge conditions by measuring the photoelectron currents induced by two lasers (He-Ne, Ar(sup +) laser) simultaneously injected onto the target. The reflectivity at each wavelength on a cesiated gold surface was measured and taken into account in deriving the work function from the photoelectron current measured. The dependence of the Au(sup -) production rate, defined as the ratio of Au(sup -) current to the target current, on the work function of the target surface was obtained from simultaneous measurements of both target surface work function and Au(sup -) production rate while the Cs coverage was changed due to the plasma ion sputtering. The observed minimum work function of a cesiated gold surface in an argon plasma was 1.3 eV, when the negative ion production rate took the maximum value. The production rate increased monotonically and saturated when the surface work function was reduced from 1.9 eV to 1.3 eV. This range of the change in the work function was limited by the wave lengths of lasers used for the determination of the work function. The dependence of Au(sup -) production rate on the incident ion energy was deduced by changing the target bias voltage while the work function was kept constant. The production rate increased with the target bias voltage, and showed a similar dependence on the incident ion energy as the sputtering rate of gold with Ar(sup +) bombardment. The dependence of Au(sup -) production rate on the number of the incident ion was studied by changing the plasma discharge current, while the work function was again kept constant.

Author

N92-31255# National Inst. for Fusion Science, Nagoya (Japan).
**ELECTRON IMPACT EXCITATION OF POSITIVE IONS:
 PARTIAL WAVE APPROACH IN COULOMB-EIKONAL
 APPROXIMATION**

WEN-JIA QIAN (Liaoning Inst. of Metrology, Shenyang, China), YUN-BO DUAN (Liaoning Inst. of Metrology, Shenyang, China), RONG-LONG WANG (Liaoning Inst. of Metrology, Shenyang, China), and H. NARUMI (Hiroshima Univ., Japan) Sep. 1991 17 p (ISSN 0915-633X)

(NIFS-106) Avail: CASI HC A03/MF A01

The eikonal partial wave theory for the electron impact excitation of positive ions is formulated firstly and is demonstrated in the 1s to 2s, 2p excitations of hydrogen-like ions.

Author

N92-31728# Kyoto Univ., Kumatori (Japan). Research Reactor Inst.

**PROCEEDINGS OF THE 2ND KUR SYMPOSIUM ON
 HYPERFINE INTERACTIONS**

M. MEKATA, ed. (Fukui Univ., Japan), T. MINAMISONO, ed., and Y. KAWASE, ed. Oct. 1991 95 p Presented at the 2nd KUR Symposium on Hyperfine Interactions, Kumatori (Japan), 29-31 Jul. 1991

(DE92-789024; KURRI-TR-358; CONF-9107216) Avail: CASI HC A05/MF A01

Hyperfine interactions between a nuclear spin and an electronic spin discovered from hyperfine splitting in atomic optical spectra have been utilized not only for the determination of nuclear parameters in nuclear physics but also for novel experimental techniques in many fields such as solid state physics, chemistry, biology, mineralogy, and for diagnostic methods in medical science. Experimental techniques based on hyperfine interactions yield information about microscopic states of matter so that they are important in material science. Probes for material research using hyperfine interactions have been nuclei in the ground state and radioactive isotopes prepared with nuclear reactors or particle accelerators. But the use of muons generated from accelerators is growing. Such wide spread application of hyperfine interaction techniques gives rise to some difficulty in collaboration among various research fields. This report summarizes the KUR symposium in the hope that this information will help to alleviate the problem.

DOE

NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

A92-21732

**INDUCTION LINEAR ACCELERATORS WITH HIGH-TC BULK
 SUPERCONDUCTOR LENSES**

HIDENORI MATSUZAWA, HARUHISA WADA, SATOSHI MORI, and TADASHI YAMAMOTO (Yamanashi University, Kofu, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Nov. 1991, p. 2972, 2973. refs

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An induction accelerator which has high-Tc bulk superconductor lenses (Supertrons) instead of solenoidal coils is presented and demonstrated. Ne-pressure dependences of accelerated electron beams are observed. It is proposed that Supertrons can replace conventional solenoidal coils to focus and transport charged-particle beams in beam-handling devices.

P.D.

A92-27295

**MEASUREMENT OF THE LI-8(A,n)B-11 REACTION CROSS
 SECTION AT ENERGIES OF ASTROPHYSICAL INTEREST**

R. N. BOYD (Institute for Physical and Chemical Research, Wako, Japan; Ohio State University, Columbus), I. TANIHATA, N. INABE, T. KUBO, T. NAKAGAWA, T. SUZUKI, M. YONOKURA (Institute for Physical and Chemical Research, Wako, Japan), X. X. BAI (Institute of Atomic Energy, Beijing, People's Republic of China), K. KIMURA (Kyushu University, Fukuoka, Japan), S. KUBONO (Tokyo, University, Tanashi, Japan) et al. Physical Review Letters (ISSN 0031-9007), vol. 68, March 2, 1992, p. 1283-1286. Research supported by Institute for Physical and Chemical Research. refs (Contract NSF PHY-89-20606)

Copyright

The cross section for the Li-8(a,n)B-11 reaction - which is crucial to predictions of primordial nucleosynthesis in inhomogeneous models - is measured using a radioactive-beam facility. The reaction cross section to all allowed B-11 states was found to be larger than that to just the B-11 ground state by about a factor of 5.

Author

A92-44877

**OBSERVATION OF COHERENT TRANSITION RADIATION AT
 MILLIMETER AND SUBMILLIMETER WAVELENGTH**

Y. SHIBATA, K. ISHI, T. TAKASHI, T. KANAI, M. IKEZAWA (Tohoku University, Sendai, Japan), K. TAKAMI, T. MATSUYAMA, K. KOBAYASHI, and Y. FUJITA (Kyoto University, Osaka, Japan) Physical Review A (ISSN 1050-2947), vol. 45, no. 12, June 15, 1992, p. R8340-R8343. Research supported by MOESC. refs

Copyright

Coherent transition radiation has been observed in the wavelength range from 0.5 to 5.5 mm emitted from bunched electrons of 42 MeV passing through an Al foil in vacuum. The radiation intensity at 4 mm is enhanced by a factor of 3×10^6 in comparison with incoherent transition radiation. The intensity is proportional to the square of the beam current, and it increases with the emission length, or the length of the trajectory of the electrons between the foil and a mirror to observe the radiation. The divergence of radiation increases with the wavelength, and it is qualitatively in agreement with theory. A sheet of Eccosorb is also used as a radiator, and a similar spectrum to that from the Al foil has been observed. The bunch shape is discussed on the basis of a bunch form factor derived from the spectrum.

Author

N92-15747# Japan Atomic Energy Research Inst., Tokyo.
**CONCEPTUAL DESIGN OF THE ADVANCED MARINE
 REACTOR MRX**

Feb. 1991 559 p In JAPANESE; ENGLISH summary (DE91-508048; JAERI-M-91-004) Avail: CASI HC A24/MF A04

Design studies on the advanced marine reactors have been done continuously since 1983 at the Japan Atomic Energy

Research Institute (JAERI) in order to develop attractive marine reactors for the next generation. At present, two marine reactor concepts are being formulated. One is 100 MWt MRX (Marine Reactor X) for an icebreaker and the other is 300 kWe DRX (Deep-sea Reactor X) for a deep-sea research vessel. They are characterized by an integral type pressurized water reactor (PWR) built-in type control rod drive mechanisms, a water-filled container and a passive decay heat removal system, which realize highly passive safe and compact reactors. This paper is a detailed report including all major results of the MRX design study. DOE

N92-15748# Japan Atomic Energy Research Inst., Tokyo.
BASIC DESIGN FOR THE RF SYSTEM OF THE SYNCHROTRON IN THE LARGE SYNCHROTRON RADIATION FACILITY (SPRING-8)
 KOICHI NAKAYAMA (Toshiba Corp., Kawasaki, Japan), HIROMITSU SUZUKI, EISUKE MINEHARA, and TAIKAN HARAMI
 Feb. 1991 64 p In JAPANESE; ENGLISH summary
 (DE91-508050; JAERI-M-91-012) Avail: CASI HC A04/MF A01

The large synchrotron radiation facility (SPRING-8) is planned to be built at Nishiharima in Hyogo-ken. This paper describes basic designs, its philosophy and specifications of the radio frequency system in the synchrotron. DOE

N92-15749# Japan Atomic Energy Research Inst., Tokyo.
ITER NEUTRAL BEAM INJECTION SYSTEM
 YOSHIHIRO OHARA (Japan Atomic Energy Research Inst., Ibaraki.), SHIGERU TANAKA (Japan Atomic Energy Research Inst., Ibaraki.), and MASATO AKIBA (Japan Atomic Energy Research Inst., Naka.) Mar. 1991 186 p
 (DE91-508098; JAERI-M-91-052) Avail: CASI HC A09/MF A02

A Japanese design proposal of the ITER Neutral Beam Injection System (NBS) which is consistent with the ITER common design requirements is described. The injection system is required to deliver a neutral deuterium beam of 75MW at 1.3MeV to the reactor plasma and utilized not only for plasma heating but also for current drive and current profile control. The injection system is composed of 9 modules, each of which is designed so as to inject a 1.3 MeV, 10 MW neutral beam. The most important point in the design is that the injection system is based on the utilization of a cesium-seeded volume negative ion source which can produce an intense negative ion beam with high current density at a low source operating pressure. The design value of the source is based on the experimental values achieved at JAERI. The utilization of the cesium-seeded volume source is essential to the design of an efficient and compact neutral beam injection system which satisfies the ITER common design requirements. The critical components to realize this design are the 1.3MeV, 17A electrostatic accelerator and the high voltage DC acceleration power supply, whose performances must be shown prior to the construction of the ITER NBI system. DOE

N92-16785# Japan Atomic Energy Research Inst., Tokyo.
CHARACTERS OF SAGITTAL FOCUSING MONOCHROMATOR IN HIGH ENERGY REGION
 YASUHARU KASHIHARA (Japan Atomic Energy Research Inst., Ibaraki.) Feb. 1991 53 p In JAPANESE; ENGLISH summary
 (DE91-780373; JAERI-M-91-008) Avail: CASI HC A04/MF A01

A sagittal focusing monochromator will be used to monochromatize and focus the high energy photon radiated from an electron storage ring in 8 GeV class. The angle between an incident beam and crystal surface, which was given by the Bragg angle for symmetric reflection, and the Darwin width in X-ray dynamical theory were calculated for Si(111), Si(311), Si(333), Ge(111), Ge(311) and Ge(333) in a wide range of photon energy (10 similar to 100 keV). The difference between an incident angle and the Bragg angle increases further as the divergence of an incident beam increases in the geometry of sagittal focusing. We calculated the incident angle and compared it with the Bragg angle, and then investigated the scattering condition of a divergent beam for various geometries of sagittal focusing monochromator by using the numerical results of the Darwin width. DOE

N92-22970# National Lab. for High Energy Physics, Tsukuba (Japan).

EVALUATION OF WAKE FIELDS OF DISK LOADED STRUCTURE FOR JAPAN LINEAR COLLIDER

M. TAKAO, T. HIGO, and K. TAKATA Jul. 1991 25 p
 (DE92-751023; KEK-91-4) Avail: CASI HC A03/MF A01

The numerical estimation of the long range wake fields of the accelerating structure for the Japan Linear Collider (JLC) was carried out by using various computer codes; TBCI, KN7C, TRANSVRS, and URMEL. It provides the basis of the argument on the energy distribution or the emittance growth of a multi-bunched beam. A large portion of the transverse wake field was found to be occupied by a dominant mode, lowest in frequency, while the contribution of the other modes were found at most twenty percent. On the wake field of the dominant mode, the estimation of the amount calculated by the above codes agreed within ten percent. The dependence of the wake fields on a geometric variation, i.e., an aperture, was also investigated. DOE

N92-23713# National Lab. for High Energy Physics, Tsukuba (Japan).

REPORT FROM ORBIT SUB-GROUP OF TASK FORCE FOR MR SYNCHROTRON RADIATION PROJECT

M. KOBAYASHI, ed. Jul. 1991 133 p In JAPANESE; ENGLISH summary
 (DE92-751024; KEK-91-5) Avail: CASI HC A07/MF A02

This report includes feasibility studies for a new synchrotron radiation source using TRISTAN Main Ring (MR) of KEK now being used as an electron and positron collider. A task force for the feasibility study started in the spring of 1990, and a sub-group was organized to study and discuss the problems related to the lattice of MR. The main subject in this report is how to realize both very small emittance and large dynamic aperture in a new lattice. Two long straight sections in the present lattice called 'Nikko' and 'Oho' must be modified like a gable roof, 1) to get free space for insertion devices, 2) to extract their synchrotron radiation to the experimental hutches which will be set in the ring tunnel in those sections and 3) to add a radiation shielding wall between the ring and the beam channel for the synchrotron radiation. The other two long straight sections called 'Fuji' and 'Tsukuba' will be used for injection, RF cavities and damping wigglers necessary for the very low emittance. The ultimate emittance will be 1.6 nm rad with the horizontal dynamic aperture of $36 \times 10(\text{sup } -6)$ m rad that is about half the aperture experienced at the present MR. DOE

N92-25952# National Lab. for High Energy Physics, Tsukuba (Japan).

PARITY VIOLATION IN NEUTRON INDUCED REACTIONS

V. P. GUDKOV Jun. 1991 45 p
 (DE92-768076; KEK-91-2) Avail: CASI HC A03/MF A01

The theory of parity violation in neutron induced reactions is discussed. Special attention is paid to the energy dependence and enhancement factors for the various types of nuclear reactions and the information which might be obtained from P-violating effects in nuclei. DOE

N92-32746# National Inst. for Fusion Science, Nagoya (Japan).
STATUS OF LHD CONTROL SYSTEM DESIGN

K. YAMAZAKI, H. KANEKO, Y. TANIGUCHI, O. MOTOJIMA et al. Dec. 1991 17 p Presented at the International Conference on Accelerator and Large Experimental Physics Control Systems (ICALP 1991), Tsukuba, Japan, 11-15 Nov. 1991 (ISSN 0915-633X)
 (NIFS-122) Avail: CASI HC A03/MF A01

The Large Helical Device (LHD) fusion system, using 1.6 GJ superconducting (SC) magnets, is now under construction, and its plasma experiments will be started in April 1997. For this purpose, a new national institute (National Institute for Fusion Science) was established in May 1989, and a new site (Toki city) was prepared for these experiments. The main objectives of the LHD project are as follows: (1) the study of the behavior of high temperature/high density plasmas using a helical torus device for

comprehensive understanding of toroidal plasmas; and (2) the investigation of the steady-state helical system reactor. The major plasma radius of the LHD is 3.9 m, and the magnetic field strength is 3 Tesla (4 Tesla in the second experimental phase). This makes the LHD the largest SC fusion machine now under construction. To maintain flexible and reliable operations of this SC machine, a new control concept is required. The present status of the control system design for the LHD system is presented. Author

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OPTICS

Includes light phenomena; and optical devices.

A92-10056

PHASES AND THIRD-ORDER OPTICAL NONLINEARITIES IN TETRAVALENT METALLOPHTHALOCYANINE THIN FILMS

MASAHIRO HOSODA, TATSUO WADA, AKIRA YAMADA, ANTHONY F. GARITO, and HIROYUKI SASABE (Institute of Physical and Chemical Research, Wako, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1486-L1488. refs Copyright

A92-10057

NEW TYPES OF NONLINEAR OPTICAL MATERIALS - Li3VO4- AND Li3PO4-TYPE STRUCTURES

SHIN'ICHI SAKATA and ITSUHIRO FUJII (Ube Industries, Ltd., Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1489-L1492. refs Copyright

Li3VO4 and Li3PO4 types of structure crystals are found as new types of nonlinear optical materials for second-harmonic generation. Their lattices are formed of only the MO4 oxygen tetrahedra, being different from other typical nonlinear optical materials that have been developed previously. Author

A92-13455

THE UNSTABLE NONLINEAR SCHROEDINGER EQUATION AND DARK SOLITONS

TAKESHI IIZUKA, MIKI WADATI, and TETSU YAJIMA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2862-2875. refs Copyright

The inverse scattering method is used to solve the initial value problem of the unstable nonlinear Schroedinger (UNS) equation with the boundary condition absolute value of u approaches $1(x$ approaches $+\infty$). Dark soliton solutions are obtained. Position shift due to a collision of two solitons is shown to be attractive (or repulsive) when the directions of their velocities are opposite (or the same). It is also demonstrated that the UNS equation has an infinite number of conserved quantities. O.G.

A92-13664

PHASE-MATCHING OF OPTICALLY SECOND-HARMONIC GENERATION IN THE SINGLE CRYSTALS OF GD- AND LA-ADDED BARIUM SODIUM NIOBATE

MASAJI SHIMAZU, MASAYUKI TSUKIOKA (National Institute of Research in Inorganic Materials, Tsukuba, Japan), SHINICHIRO KUROIWA, YASUO TANOKURA, and SADA O TSUTSUMI (Waseda University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2002-2007. refs Copyright

A92-13682

RELATIONS AND ORTHOGONALITY PROPERTIES FOR THE GENERALIZED GAUSSIAN BEAM FUNCTIONS

MITSUHIRO YOKOTA (Kyushu University, Fukuoka, Japan), SHINJI

AONO (Mitsubishi Electric Corp., Nishinomiya, Japan), and OTOZO FUKUMITSU (Kyushu Tokai University, Kumamoto, Japan) IEICE Transactions (ISSN 0917-1673), vol. E74, Sept. 1991, p. 2935-2937. refs

Copyright

In this letter, the relations between the generalized beams with the different parameters are investigated by using the formula for the Hermite polynomials and that for the generalized Laguerre polynomials. The adjoint functions for the generalized Laguerre-Gaussian beam functions are also derived concretely. It is shown that the generalized beam is represented by a finite number of another generalized beam with the different parameter. Author

A92-14028

APPLICATION OF FIBER OPTIC COMPONENTS TO A DATA BUS

TSUYOSHI SUGAWA, YASUNORI MURAKAMI, and KUNIO TABE (Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 39, no. 452, 1991, p. 457-464. In Japanese.

The fundamentals and performance characteristics of optical fiber communication are addressed. The system design of an optical communication network is discussed, and the development of the optical transmitter and receiver, and of the nonlinear optical coupler is outlined. Y.P.Q.

A92-14658

QUASIPHASE-MATCHED SECOND HARMONIC GENERATION OF BLUE LIGHT IN ELECTRICALLY PERIODICALLY-POLED LITHIUM TANTALATE WAVEGUIDES

S. MATSUMOTO (Sony Corp., Corporate Research Laboratories, Tokyo, Japan), E. J. LIM, M. M. FEJER (Stanford University, CA), and H. M. HERTZ (Lund Institute of Technology, Sweden) Electronics Letters (ISSN 0013-5194), vol. 27, Oct. 24, 1991, p. 2040-2042. Research supported by DARPA, IBM Corp., Joint Services Electronics Program, et al. refs

Copyright

Blue light was generated at room temperature by quasiphase-matched second harmonic generation in planar and channel lithium tantalate (LiTaO3) annealed proton exchange waveguides using the d33 nonlinear coefficient. Alternating ferroelectric domains for third order quasiphase matching were created by poling the substrates with a periodic electric field. Author

A92-15747

ULTRALONG OPTICAL DEPHASING TIME IN EU(3+):Y2SiO5

RYUZI YANO, MASAHARU MITSUNAGA, and NAOSHI UESUGI (NTT, Basic Research Laboratories, Musashino, Japan) Optics Letters (ISSN 0146-9592), vol. 16, Dec. 1, 1991, p. 1884-1886. refs

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Measurements of the linear and nonlinear spectroscopic properties of Eu(3+):Y2SiO5 are reported. Two optical sites are found to have very different spectroscopic features, highlighted by the ultralong optical dephasing time (822 microsec) of one of the sites. Combined with the ultralong hole lifetime, this property makes this sample a prime candidate for frequency-selective optical memory of either the hole-burning or the photon-echo type. V.L.

A92-15748

TIME- AND FREQUENCY-DOMAIN HYBRID OPTICAL MEMORY - 1.6-KBIT DATA STORAGE IN EU(3+):Y2SiO5

MASAHARU MITSUNAGA, RYUZI YANO, and NAOSHI UESUGI (NTT, Basic Research Laboratories, Musashino, Japan) Optics Letters (ISSN 0146-9592), vol. 16, Dec. 1, 1991, p. 1890-1892. refs

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A novel type of frequency-selective optical memory that writes and reads the data in both the time domain and the frequency domain is proposed and demonstrated. Temporal 16-bit data were stored by accumulated-photon-echo bit-by-bit storage at 103

frequency addresses within the inhomogeneous line of the (F-7)0-(D-5)0 transition of $\text{Eu}(3+):\text{Y}_2\text{SiO}_5$, which yields a total memory capacity of 1.6 kbits in a single spot of 240-micron diameter. The keys to the success of this experiment are this material's long dephasing time and lack of spectral diffusion.

Author

A92-16440

AUTOMATIC OPTICAL-LOSS COMPENSATION WITH ER-DOPED FIBRE AMPLIFIER

H. OKAMURA (NTT, Transmission Systems Laboratories, Yokosuka, Japan) Electronics Letters (ISSN 0013-5194), vol. 27, Nov. 7, 1991, p. 2155, 2156. refs

Copyright

Optical losses ranging over 15 dB are automatically offset with an Er-doped fiber amplifier used in a feedback configuration. This technique can recover local optical loss while preserving phase information, and is applicable to scale-factor stabilization in interferometric fiber sensors.

Author

A92-17415

QUADRATIC ELECTROOPTIC PROPERTIES OF THE FERROELECTRIC CERAMICS OF THE TERNARY SYSTEM $\text{Sr}(\text{La}_{1/2}\text{Nb}_{1/2})\text{O}_3\text{-PbZrO}_3\text{-PbTiO}_3$

MASARU YOKOSUKA, MASAKAZU MARUTAKE (Iwaki-Mesei University, Iwaki, Japan), and TUTOMU OCHIAI (Kobayashi Institute of Physical Research, Kokubunji, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2318-2321. refs

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A92-17417

OPTICAL ASSOCIATIVE MEMORY USING LINBO3:FE HOLOGRAM

YUKIO TANAKA, ZHIMING CHEN, TADASHI KASAMATSU, and TADASHI SHIOSAKI (Kyoto University, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2359-2362. refs

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Experimental investigation is presented on an all-optical associative holographic memory with storage of more than one image using an iron-doped lithium niobate single crystal in which memories can be written, erased, and rewritten without developing treatment. Several images are multiply-stored in the single crystal volume hologram by sequentially changing their own corresponding reference beams. Then, using an image input, an output image is read out. This output image most closely resembles the input image. Threshold processing due to the sublinear photorefractive effect in the crystal is used to single out a distinct diffracted beam from the hologram.

Author

A92-17418

ELECTROOPTIC EFFECT IN HOMEOTROPICALLY ALIGNED FERROELECTRIC LIQUID CRYSTAL

MASANORI OZAKI, AKIRA TAGAWA, YUTAKA SADOHARA, SHOKO ODA, and KATSUMI YOSHINO (Osaka University, Suita, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2366-2368. refs

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New types of electrooptic effects in a homeotropically aligned cell of ferroelectric liquid crystal of (2S,3S)-3-methyl-2-chloropentanoic acid 4-prime,4-double-prime octyloxybiphenyl ester are introduced, and their characteristics are investigated. It is shown that, in an oblique incident-type homeotropic cell, the field dependence of the transmission intensity with the sharp threshold and hysteresis loop could be observed. The response

speed of this electrooptic effect was very fast, even in low driving field.

I.S.

A92-17419

ELECTRICALLY CONTROLLED SECOND-HARMONIC GENERATION IN FERROELECTRIC LIQUID CRYSTAL

MANABU UTSUMI, TATSUYA GOTOU, KAZUHIRO DAIDO, MASANORI OZAKI, and KATSUMI YOSHINO (Osaka University, Suita, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2369-2372. refs

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The angularly phase-matched second-harmonic generation (SHG) in ferroelectric liquid crystal has been studied as a function of electric field strength, sample thickness, rotating angle and temperature. A sharp angular phase-matching curve of the SHG controlled by an electric field is observed even in the liquid crystal. The temperature dependence of the phase-matched SHG in the ferroelectric phase has also been studied, and the temperature-tuned phase matching of SHG is realized by using the change in tilt angle of the ferroelectric liquid crystal.

Author

A92-17420

OPTICAL LOGIC ELEMENT USING FERROELECTRIC LIQUID CRYSTAL WITH ELECTRICAL FEEDBACK

HIROSHI MORITAKE, AKIRA TAGAWA, MASANORI OZAKI, and KATSUMI YOSHINO (Osaka University, Suita, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2373-2376. refs

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Optical bistability in surface-stabilized ferroelectric liquid crystal (SSFLC) with an electrical feedback has been studied. The hysteresis in the transmission-voltage curve which is characteristic of SSFLC is found to contribute to the expansion of the optical bistable region. Dynamic characteristics of the switching between optical bistable states by an incident light pulse have also been studied. A new multilogic element with both OR and AND functions which can be selected by controlling the duration of the reset light pulse can be realized.

Author

A92-17446

KINOFORM USING AN ELECTRICALLY CONTROLLED BIREFRINGENT LIQUID-CRYSTAL SPATIAL LIGHT MODULATOR

JUN AMAKO and TOMIO SONEHARA (Seiko Epson Corp., Research and Development Div., Suwa, Japan) Applied Optics (ISSN 0003-6935), vol. 30, Nov. 10, 1991, p. 4622-4628. refs

Copyright

A programmable kinoform using an electrically controlled birefringent liquid-crystal spatial modulator (ECB-LCSLM) is discussed. The LCSLM is capable of continuous phase modulation from 0 to 2π . For the kinoform generation, the phase distribution is calculated by iterative methods and recorded on the LCSLM with 16 quantizing levels. The characteristics and the structure of the LCSLM for the implementation of the programmable kinoform are discussed and the computed results and optical reconstruction are compared.

Author

A92-18417

TRANSIENT PHASE CONJUGATION IN A TWO-LEVEL SYSTEM

HIDETOSHI NAKANO and JUN-ICHI SAKAI (NTT, Basic Research Laboratories, Musashino, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 27, Nov. 1991, p. 2495-2504. refs

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An analytical expression for conjugate signals is developed for a case where three rectangular pulses with the same center frequency are injected into a two-level system. The Maxwell's equation is solved with the slowly varying envelope approximation

and with the perturbative third-order nonlinear polarization expression of a two-level system. Numerical examples are discussed in such a way that the input pulsewidth is changed relative to the energy relaxation and dephasing times. As the optical pulsewidth becomes short, ripples appear in the signal pulse due to the beat between the optical field and the resonant oscillation of the atomic system. I.E.

A92-18425**ELECTROOPTIC LIGHT MODULATION AND SECOND-HARMONIC GENERATION IN NOVEL DIAZO-DYE-SUBSTITUTED POLED POLYMERS**

YOSHITO SHUTO, MICHYUKI AMANO, and TOSHIKUNI KAINO (NTT, Opto-Electronics Laboratories, Ibaraki, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Nov. 1991, p. 1003-1006. refs

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The nonlinear-optical susceptibilities, χ^2 exp (2), of a diazo-dye-substituted polymer poled with high electric fields were determined experimentally and theoretically. The electrooptic modulation of He-Ne laser light in a traveling-wave channel-waveguide modulator using the diazo-dye-substituted poled polymer is reported, and the linear electrooptic coefficient of the poled polymer is estimated from a measured half-wave voltage. The polymer studied is a poly(methyl methacrylate) copolymerized with a methacrylate ester of the dicyanovinyl-terminated diazo dye derivative. This polymer is called 3RDCVXY. The corona-poled 3RDCVXY polymer exhibits a χ^2 exp (2) value of 1×10^{-6} esu at 1.06 micron. The thermal stability is excellent even at 80 C. The poled 3RDCVXY polymer film shows a linear electrooptic coefficient as high as 40 pm/V at 0.633 micron. An electrooptic light modulation in the channel 3RDCVXY polymer waveguides with a half-wave voltage as low as 5 V was obtained. I.E.

A92-18428**THZ OPTICAL-FREQUENCY CONVERSION OF 1 GB/S-SIGNALS USING HIGHLY NONDEGENERATE FOUR-WAVE MIXING IN AN INGAASP SEMICONDUCTOR LASER**

S. MURATA, A. TOMITA, J. SHIMIZU, and A. SUZUKI (NEC Corp., Opto-Electronics Research Laboratories, Kawasaki, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Nov. 1991, p. 1021-1023. refs

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The authors report the application of the highly nondegenerate four-wave mixing (HNDFWM) process to a 1.5-micron InGaAsP semiconductor laser in optical-frequency conversion experiments on 1-Gb/s intensity-modulated signals in a 1-THz conversion range. This conversion is based on a subpicosecond ultrafast nonlinear gain process in the laser. The HNDFWM was generated through the use of an injection-locking technique. The possibility of applying this phenomenon to an optical fiber dispersion compensator is also discussed. I.E.

A92-18435**A NOVEL MODULATION SCHEME IN SEMICONDUCTOR LIGHT EMITTERS WITH QUANTUM MICROCAVITIES - HIGH SPEED INTENSITY MODULATION BY SWITCHING OF COUPLING EFFICIENCY OF SPONTANEOUS EMISSION**

MASAMICHI YAMANISHI, TSUTOMU SHIOTANI (Hiroshima University, Japan), and YOSHIHISA YAMAMOTO (NTT, Basic Research Laboratories, Musashino, Japan) IEEE Photonics Technology Letters (ISSN 1041-1135), vol. 3, Oct. 1991, p. 888-890. Research supported by MOESC. refs

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A modulation of coupling efficiency of spontaneous emission is proposed theoretically to result in an ultrawideband modulation of spontaneous output intensity in semiconductor light-emitting devices with quantum microcavities. The proposed modulation scheme does not involve changes in carrier population, but relies purely on the modulation of the coupling efficiency of spontaneous emission caused by electric-field-induced tuning of emission

wavelength. An extremely wideband modulation is predicted, showing a cutoff frequency over 10^{11} Hz and being completely free of recombination lifetime limitation. I.E.

A92-20337**PERFORMANCE OF A WIDEBAND SOFT X-RAY POLARIZER**

TAKUMI MAEHARA (Nippon Steel Corp., Tokyo, Japan), HIROAKI KIMURA (Graduate University for Advanced Studies, Tsukuba, Japan), HIROSHI NOMURA, MIHIRO YANAGIHARA, and TAKESHI NAMIOKA (Tohoku University, Sendai, Japan) Applied Optics (ISSN 0003-6935), vol. 30, Dec. 1, 1991, p. 5018-5020. Research supported by MOESC. refs

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The performance of a Ru/Si multilayer polarizer of the double-crystal monochromator type was evaluated in the soft X-ray region. Preliminary results obtained for the soft X-ray range of 80-120 eV show that the polarizer provides a high throughput of greater than 5 percent with a maximum of about 32 percent at 99 eV and that its polarization is higher than 99.5 percent at 89 and 97 eV. L.M.

A92-20687**OPTICAL TRIODE OPERATION CHARACTERISTICS OF NONLINEAR ETALONS**

HIROYUKI TSUDA, SEIJI FUKUSHIMA, and TAKASHI KUROKAWA (NTT, Opto-Electronics Laboratories, Atsugi, Japan) Applied Optics (ISSN 0003-6935), vol. 30, Dec. 10, 1991, p. 5136-5142. refs

Copyright

The optical triode operation characteristics of nonlinear etalons are investigated with emphasis on on-off ratio, fan-out, thresholding power, and switching time. Dependences and trade-offs with regard to various factors, especially operating conditions, are examined. Several logic operations are demonstrated with ZnSe nonlinear etalons both in transmission and reflection type devices. V.L.

A92-22045**PHOTO-MODULATION OF LIGHT UP-CONVERSION IN LIGHT TRANSDUCER USING HIGH-GAIN PHOTORESPONSIVE AMORPHOUS SILICON CARBIDE COMBINED WITH ORGANIC ELECTROLUMINESCENT DIODE**

MASAHITO HIRAMOTO, KANJI YOSHIMURA, and MASAOKI YOKOYAMA (Osaka University, Suita, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 20, 1992, p. 324, 325. refs

Copyright

Photo-modulation of light up-conversion was successfully demonstrated in a new type of light transducer using a high-gain photoresponsive amorphous silicon carbide (a-SiC:H) combined with an organic electroluminescent (EL) diode. Green EL output up-converted from red input-light was reversibly photo-modulated by the simultaneously irradiated ultraviolet light due to the effective suppression of photocurrent multiplication in a-SiC:H film. The present device can be applicable to the logic device for two-dimensional optical computing. Author

A92-22254**POLARIZATION PROPERTIES OF FUSED FIBER COUPLERS AND POLARIZING BEAMSPLITTERS**

KATSUMI MORISHITA and KATSUYOSHI TAKASHINA (Osaka Electro-Communication University, Neyagawa, Japan) Journal of Lightwave Technology (ISSN 0733-8724), vol. 9, Nov. 1991, p. 1503-1507. Research supported by Nippon Mining Co., Ltd. refs

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The polarization properties of fused tapered fiber couplers were investigated experimentally by changing cross-sectional shapes at the coupler waist. The coupling difference between x and y polarized light was studied for many test fused fiber couplers with various cross-sectional shapes. On the basis of the experimental results, two polarizing beamsplitters with the aspect ratio of 1.1 and 1.8 were produced, and their chromatic characteristics were measured. It was evident that the aspect ratio should be more than 1.7 to manufacture polarizing beamsplitters with few power

transfer cycles, i.e., long spectral period. Splitting ratios of polarizing beamsplitters with the aspect ratio of 1.1 and 1.8 were 17.6 and -12.7 dB for x polarized light and -16.1 and 11.7 dB for y polarized light, respectively. Their losses were less than 0.6 and 0.3 dB.

I.E.

A92-22257

A FINESSE-ENHANCED ER-DOPED-FIBER RING RESONATOR
HARUO OKAMURA and KATSUMI IWATSUKI (NTT, Transmission Systems Laboratories, Yokosuka, Japan) *Journal of Lightwave Technology* (ISSN 0733-8724), vol. 9, Nov. 1991, p. 1554-1560. refs

Copyright

A two-coupler-type Er-doped-fiber ring resonator that compensates for the round-trip optical loss by optical amplification is proposed. Also proposed is a mode-filtered heterodyne method for resonant-linewidth measurements which does not demand narrow-linewidth light sources, but uses the beat noise between two uncorrelated lights filtered by the resonator passband. With this method, a finesse of at least 500 and a resonant linewidth of not more than 17 kHz were confirmed from the Er-doped fiber ring resonator. The ring resonator was operated as a high-resolution optical spectrum analyzer.

I.E.

A92-23913

IMAGE ENCRYPTMENT BASED ON OPTICAL PARALLEL PROCESSING USING SPATIAL LIGHT MODULATORS
SEIJI FUKUSHIMA, TAKASHI KUROKAWA, and YOSHIHISA SAKAI (NTT, Opto-Electronics Laboratories, Kanagawa, Japan) *IEEE Photonics Technology Letters* (ISSN 1041-1135), vol. 3, Dec. 1991, p. 1133-1135. refs

Copyright

All-optical image coding and decoding are demonstrated for image encipherment communication. The optical parallel coder consists of two cascaded bipolar-operational spatial light modulators (BSLMs) that can select positive and negative image readout in response to the electrical pulse polarity. Coding is performed by an exclusive-OR operation to a key and an input image, while decoding is the same operation performed to a decoding key and an enciphered image. Coding was performed within a 8-ms duration, which is even faster than the conventional television system. Increasing the voltages to the BSLMs two-fold or three-fold and shortening the pulse durations speed up the processing rate.

I.E.

A92-25117

PHOTOCHROMISM INDUCED IN AN ELECTROLYTICALLY PRETREATED MOO₃ THIN FILM BY VISIBLE LIGHT
J. N. YAO, K. HASHIMOTO, and A. FUJISHIMA (Tokyo, University, Japan) *Nature* (ISSN 0028-0836), vol. 355, Feb. 13, 1992, p. 624-626. refs

Copyright

The preparation of visible-light sensitive, reversibly photochromic films of MoO₃ is reported. Pretreated, vacuum-evaporated MoO₃ thin films were slightly blue by cathodic polarization in a nonaqueous electrolyte; subsequent irradiation with visible light in air produced a strong color enhancement. The photochromism could be erased by anodic polarization, and the coloration-decoloration process was repeatable over at least five cycles. The behavior of these films contrasted with those blueed by bandgap irradiation, which were not responsive to visible light.

C.D.

A92-25837

INGAAS-INALAS MULTIPLE QUANTUM WELL OPTICAL BISTABLE DEVICES USING THE RESONANT TUNNELING EFFECT
YUICHI KAWAMURA, HIROMITSU ASAI, SHINJI MATSUO, and CHIKARA AMANO (NTT, Opto-Electronics Laboratories, Atsugi, Japan) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, Jan. 1992, p. 308-314. refs

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New types of InGaAs-InAlAs multiple quantum well (MQW)

optical bistable devices using the resonant tunneling effect are investigated. The bistability of these devices is obtained by the negative differential resistance (NDR) of the MQW resonant tunneling diodes (RTDs). Two types of MQW bistable devices are described. One is an MQW optical bistable device consisting of an MQW-RTD and an MQW modulator. Light-output-light-input bistable operation is obtained for this device at room temperature. The other is an InGaAs-InAlAs MQW resonant tunneling phototransistor (MQW-RPT), which shows a clear bistability in the collector-current-light-input characteristic. Inverter-type optical bistable operation with an on/off ratio of more than 10 dB is obtained by using the MQW-RPT as a laser driver. Optical memory operation is also demonstrated.

I.E.

A92-25861

DEMONSTRATION OF SIMULTANEOUS FDM SIGNAL SWITCHING BY POLARIZATION-CONTROLLED SWITCH FOR SURVIVABLE FIBER NETWORKS

YUTAKA KATSUYAMA, TOSHIKI SATAKE, YOSHITO FUKASAKU (NTT, Transmission Systems Laboratories, Ibaraki, Japan), and TETSUO YOSHIZAWA (NTT, Opto-Electronics Laboratories, Ibaraki, Japan) *IEEE Photonics Technology Letters* (ISSN 1041-1135), vol. 4, Jan. 1992, p. 88-91. refs

Copyright

A polarization-controlled switch is proposed for survivable fiber network construction to retain high survivability in case of fiber failure. The switching performance was demonstrated for FSK modulated FDM signals. The FDM signals were switched simultaneously and no degradation was observed in the bit-error-rate performance. The switch has an almost constant loss and crosstalk better than 20 dB in the 1.51-1.59-micron wavelength range, which is much wider than that of the gain spectrum of the Er³⁺-doped optical amplifier.

I.E.

A92-26508

SPONTANEOUS EMISSION IN A VERY SHORT OPTICAL CAVITY WITH PLANE-PARALLEL DIELECTRIC MIRRORS
KIKUO UJIHARA, ATSUSHI NAKAMURA, OSAMU MANBA, and XIAO-PING FENG (University of Electro-Communications, Chofu, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3388-3398. refs

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A detailed account of the calculation on the spontaneous emission rate in a very short optical cavity with plane-parallel dielectric mirrors is given. A cavity model consisting of a pair of plane dielectric slabs is used. Guided modes as well as outgoing modes are considered. The emission rate from a two-level atom is calculated under quantum-mechanical perturbation approximation. The enhancement factor for the rate is found to be of the order of unity except for extremely short cavities. The concept of quasimodes in a very short cavity and their effective area are discussed in relation to the enhancement factor. The coupling ratios into various quasimodes are derived.

Author

A92-26509

EFFECTS ON BaTiO₃ SELF-PUMPED PHASE-CONJUGATION IN 400-M ATMOSPHERIC OPTICAL PATH
TOKUYUKI HONDA and HIROKAZU MATSUMOTO (National Research Laboratory of Metrology, Tsukuba, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3399-3402. refs

Copyright

A 400-m optical path is constructed through the atmosphere using a self-pumped phase-conjugate mirror (PCM) of a photorefractive BaTiO₃ crystal as a retroreflector. The intensity fluctuations of the laser beams are reduced by 10 dB compared to the case of a conventional plane-reflecting mirror. Moreover, some additional advantages of using the PCM in such a long-optical-path system are discussed.

Author

A92-26578

HIGH RESOLUTION SPATIAL LIGHT MODULATOR
NARIHIRO YOSHIDA and KATSUO HARA (Hamamatsu Photonics,

Japan) IN: Optical information-processing systems and architectures II; Proceedings of the Meeting, San Diego, CA, July 9-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 357-363. refs
Copyright

The present spatial light modulator employs an amorphous silicon photoconductor and a nematic liquid crystal to yield 501 p/mm MTF. The resolution is found to be improved by thinning the photoconductor and liquid crystal, as well as through the optimization of the device's driving condition. Device response is limited by liquid crystal response; it is anticipated that faster response will be possible through the use of a ferroelectric liquid crystal. O.C.

A92-26581

USE OF MICRO-CHANNEL PLATE SPATIAL LIGHT MODULATOR IN OPTICAL NEURAL COMPUTING

TOYOHICO YATAGAI (Tsukuba, University, Japan) IN: Optical information-processing systems and architectures II; Proceedings of the Meeting, San Diego, CA, July 9-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 394-402. refs
Copyright

An optical three-layer neural network and an associative network system for a semantic network using a microchannel plate spatial light modulator (MSLM) are described. In the optical three-layer neural network, the back-propagation learning algorithm is used to calculate optimum weight matrices. Experimental results on learning of exclusive OR operation are presented. In the optical implementation of the associative system, an MSLM is used to store an optimum weight matrix. The optimum weight matrix is calculated by a dynamic learning rule. Author

A92-27676

EPOXY-AMINE POLYMER WAVEGUIDE CONTAINING NONLINEAR OPTICAL MOLECULES FABRICATED BY CHEMICAL VAPOR DEPOSITION

SATOSHI TATSUURA, WATARU SOTOYAMA, and TETSUZO YOSHIMURA (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, March 9, 1992, p. 1158-1160. refs

Copyright

Epoxy-amine polymer thin films are fabricated by chemical vapor deposition using an aliphatic amine, which is very reactive to epoxy groups and has nonlinear optical properties. A transparent thin film is obtained by controlling the temperature and surface condition of the substrate, and the epoxy-amine ratio during deposition. The refractive index of the film is 1.648. A slab waveguide is constructed by depositing the polymer film on SiO₂ which is formed by thermal oxidation of a Si wafer. End coupling of a He-Ne laser (632.8 nm) launches a well-propagating beam. This is the first case in which a polymer waveguide is fabricated by dry processing. Author

A92-27818

OBSERVATION OF SECOND HARMONIC GENERATION FROM OPTICALLY TRAPPED MICROSCOPIC LiNbO₃ PARTICLE USING Nd:YAG LASER

S. SATO and H. INABA (Tohoku University, Sendai, Japan) Electronics Letters (ISSN 0013-5194), vol. 28, Jan. 30, 1992, p. 286, 287. refs

Copyright

Optical trapping of a microscopic LiNbO₃ particle is demonstrated using a single beam from a CW Nd:YAG laser at 1.064 micron for the first reported time. The simultaneous generation of a second harmonic wave from the LiNbO₃ particle induced by the trapping laser light itself is also confirmed by the emission spectrum at 532 nm and by its intensity variation that is almost proportional to the square of the input Nd:YAG laser power ranging from several milliwatts to 40 mW. Author

A92-29511

LIGHT EMISSION FROM MICROCRYSTALLINE Si CONFINED IN SiO₂ MATRIX THROUGH PARTIAL OXIDATION OF ANODIZED POROUS SILICON

TOSHIMICHI ITO, TOSHIMICHI OHTA, and AKIO HIRAKI (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Jan. 15, 1992, p. L1-L3. refs
Copyright

Optical properties of microcrystalline Si embedded in a SiO₂ matrix through a partial oxidation of anodized porous silicon using a wet process have been studied. Thick (about 30 microns) films thus obtained were dark red to light yellow in color, depending on the oxidation condition. The fundamental edge of the absorption spectra shifted to the higher energy side with increasing oxide fractions in the colored specimen. Visible light emission from these specimens were observed at room temperature with photoexcitations using a He-Cd laser. All of the data, including the broadening effect in X-ray diffraction peaks, can be explained in terms of the size reduction effect of the Si islands confined in the SiO₂ matrix. Author

A92-31744

OPERATIONAL WAVELENGTH RANGE OF GaInAs(P)-INP INTERSECTIONAL OPTICAL SWITCHES USING FIELD-INDUCED ELECTROOPTIC EFFECT IN LOW-DIMENSIONAL QUANTUM-WELL STRUCTURES

KAZUHIKO SHIMOMURA, SHIGEHISA ARAI, and YASU HARU SUEMATSU (Tokyo Institute of Technology, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Feb. 1992, p. 471-478. Research supported by MOESC and Tepco Research Foundation. refs

Copyright

Operational wavelength range for low insertion loss and high extinction ratio of GaInAs(P)-InP intersectional optical switches consisting of low-dimensional quantum-well structures, such as quantum-box, quantum-wire, and quantum-film structures, is theoretically analyzed. It is found that superior operation characteristics can be attained with the lower-dimensional quantum-well structure. For instance, an operational wavelength range of around 10 nm for an insertion loss less than 1 dB and an extinction ratio higher than 50 dB can be obtained with the device using a quantum-box structure. I.E.

A92-31745

ANALYSIS ON INTERBAND-RESONANT LIGHT MODULATION BY INTERSUBBAND-RESONANT LIGHT IN N-DOPED QUANTUM WELLS

SUSUMU NODA, TETSUYA UEMURA, TAKAO YAMASHITA, and AKIO SASAKI (Kyoto University, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Feb. 1992, p. 493-500. Research supported by MOESC and Inamori Foundation. refs
Copyright

The authors describe a theoretical analysis on interband-resonant light modulation by intersubband-resonant light in the n-doped quantum well. The modulation principle is briefly explained. The theoretical formulation for the modulation is derived by using density matrix theory. The modulation characteristics concerning the absorption coefficient and refractive index are calculated for various parameters. It is shown that the absorption coefficient for the interband-resonant light can be greatly changed by the incidence of intersubband-resonant light. I.E.

A92-31749

EFFECTS INDUCED BY TRANSIT TIME ON A COUPLED TWO-ELEMENT OPTICAL BISTABLE DEVICE

JYH-LONG CHERN, KENJU OTSUKA (NTT, Basic Research Laboratories, Musashino, Japan), and PAUL MANDEL (Bruxelles, Universite Libre, Brussels, Belgium) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, Feb. 1992, p. 555-561. Research supported by NTT. refs
Copyright

The authors study the effects of finite transit time, i.e., delay, on dynamics in a coupled two-element optical bistable device.

Finite transit time is considered because of signal propagation between the elements. It is shown that delay can be used as a measure of crosstalk between the coupled elements and it will increase the lethargy time. Thus, many interesting, transient phenomena take place both in hysteresis and pitchfork (symmetry-breaking) regimes. Symmetry-recovering crisis originating from the collision between the unstable periodic orbit and chaotic asymmetrical solution is predicated to occur for T roughly τ (T : transit time, τ : response time of nonlinear medium). It is shown that symmetry-recovering crisis results in switching failure in set-reset (S-R) flip-flop operations with a pitchfork bifurcation structure. I.E.

A92-31758

OSCILLATION MODES OF LASER DIODE PUMPED HYBRID BISTABLE SYSTEM WITH LARGE DELAY AND APPLICATION TO DYNAMICAL MEMORY

TAHITO AIDA and PETER DAVIS (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, March 1992, p. 686-699. refs
Copyright

An electrooptical bistable system with a very large delay was constructed, and self-oscillation phenomena were investigated. Many multistable self-oscillation modes were observed, including second-order bifurcations of the 265th harmonic. The dynamical memory function was demonstrated by locking second order bifurcated modes to external clock oscillations and performing WRITE and READ of binary data sequences in the waveforms of the bifurcated modes. The nonlinear bifurcation phenomena in this system are applicable for large-capacity memory and signal processing. Spurious preferential excitation of particular harmonic modes was related to the fine structure in the transfer spectrum of the open loop associated with spurious resonances in the electrooptical modulator used as a nonlinear element. Missing harmonics could be recovered by pumping with small sinusoidal signals of the corresponding frequencies. I.E.

A92-32959

OPTICAL NONLINEAR RESPONSES OF A QUANTUM WELL PHOTODIODE WITH A NON-OHMIC CONTACT

YUJI ABE, YASUNORI TOKUDA, KYOZO KANAMOTO, and NORIAKI TSUKADA (Mitsubishi Electric Corp., Amagasaki, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, April 6, 1992, p. 1664-1666. refs
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The dependence of photocurrent properties on incident optical power in a quantum well p-i-n photodiode with a nonohmic contact was investigated. The experimental results showed that a significant absorption peak shift, in an extremely low optical power range, as well as a notable modification in the spectral shape at a higher power range was observed, without any external feedback element. The mechanism for the optical nonlinear responses can be explained in terms of the built-in field screening at the p-i-n junction or by taking into account the load characteristics of the Schottky-like contact. Author

A92-33972

PHYSICS AND DEVICE APPLICATIONS OF OPTICAL MICROCAVITIES

H. YOKOYAMA (NEC Corp., Opto-Electronics Research Laboratories, Tsukuba, Japan) Science (ISSN 0036-8075), vol. 256, April 3, 1992, p. 66-70. refs
Copyright

Optical microcavities are resonators that have at least one dimension on the order of a single optical wavelength. These structures enable one to control the optical emission properties of materials placed inside them. They can, for example, modify the spatial distribution of radiation power, change the spectral width of the emitted light, and enhance or suppress the spontaneous emission rate. In addition to being attractive for studying the fundamental physics of the interaction between materials and vacuum field fluctuations, optical microcavities hold technological

promise for constructing novel kinds of light-emitting devices. One of their most dramatic potential features is thresholdless lasing. In this way and others, controlled spontaneous emission is expected to play a key role in a new generation of optical devices. Author

A92-33992* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

LAYER-BY-LAYER DESIGN METHOD FOR SOFT-X-RAY MULTILAYERS

MASAKI YAMAMOTO (Tohoku University, Sendai, Japan) and TAKESHI NAMIOKA (NASA, Goddard Space Flight Center, Greenbelt, MD) Applied Optics (ISSN 0003-6935), vol. 31, April 1, 1992, p. 1622-1630. refs
(Contract MOESC-01651002; MOESC-63420023)
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A new design method effective for a nontransparent system has been developed for soft-X-ray multilayers with the aid of graphic representation of the complex amplitude reflectance in a Gaussian plane. The method provides an effective means of attaining the absolute maximum reflectance on a layer-by-layer basis and also gives clear insight into the evolution of the amplitude reflectance on a multilayer as it builds up. An optical criterion is derived for the selection of a proper pair of materials needed for designing a high-reflectance multilayer. Some examples are given to illustrate the usefulness of this design method. Author

A92-37221

POWER COUPLING EQUATIONS FOR SINGLE-MODE, SINGLE-POLARIZATION OPTICAL FIBERS WITH EFFECTS OF LEAKY MODES AND BROAD-BAND LIGHT SOURCE

CHAO-XIANG SHI and TAKANORI OKOSHI (Tokyo, University, Japan) IEEE Microwave and Guided Wave Letters (ISSN 1051-8207), vol. 2, no. 4, April 1992, p. 133, 134. refs
Copyright

A set of coupled equations for single-mode single-polarization (SMSP) optical fibers applicable to the case with effects of leaky modes and broad-band light source has been derived. The power coupling coefficients are related not only to the birefringence of the SMSP fiber, but also to the leaky mode loss and the spectral line width of the light source. Author

A92-37357

LINEAR AND NONLINEAR OPTICAL PROPERTIES OF CDSE MICROCRYSTALLITES IN GLASSES

T. TOKIZAKI, H. AKIYAMA, M. TAKAYA, and A. NAKAMURA (Nagoya University, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 603-607. refs
Copyright

In the present study of the linear and nonlinear properties of glass matrix-embedded CdSe microcrystallites whose radii are in the 2-12 micron range, transient absorption spectra obtained via femtosec pump-probe elucidate the relaxation processes of the confined electrons and holes in the microcrystallites. When the radius of the microcrystallite is smaller than that of the exciton, the optical transition between the quantized levels of an electron and of a hole is blocked by the existence of photoexcited carriers in these levels and in the shallow trap centers; when it is larger, there occurs the relaxation of hot carriers with phonon emission that is typical of bulk crystals. O.C.

A92-37792

NOVEL DUAL WAVELENGTH ELECTRO-OPTICAL BISTABILITY IN INGAAS/ALGAAS MULTIPLE QUANTUM WELLS

STEPHEN GIUGNI, KENJI KAWASHIMA, KENZO FUJIWARA (ATR Optical and Radio Communications Laboratories, Kyoto, Japan), and NAOKATSU SANO (Kwansei Gakuin University, Nishinomiya, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 3B, March 15, 1992, p. L313-L315. refs
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Novel dual wavelength electrooptical bistability has been

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demonstrated in a resistor biased InGaAs/AlGaAs multiple quantum well self-electrooptic effect device by the use of $n = 1$ and $n = 2$ electron to heavy-hole exciton states. A new concept is proposed to obtain a dual wavelength optical set-reset latch in a single device structure, and the clear bistable operation is evidenced by photocurrent switching experiments. Advantages of this new device configuration are discussed. Author

A92-37796

OPTICAL IMAGE PROCESSING USING LIQUID CRYSTAL PANELS

YASUYUKI HANAZAWA and TATSUO UCHIDA (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 3B, March 15, 1992, p. L349-L351. refs

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The authors have already proposed an optical parallel logic device using two liquid crystal panels and three color polarizers with suitable absorption property. This device can execute all sixteen types of binary logic by changing the wavelength and direction of polarization of incident light. In this paper, the authors propose an optical parallel logic device in which the number of wavelengths required for the operation is decreased from four to three, thereby eliminating the need for a steep absorption edge for the color polarizers, which enables the use of commercially available color polarizers. Author

A92-37797

DUAL WAVELENGTH ELECTRO-OPTICAL BISTABILITY IN AN ASYMMETRIC SELF-ELECTRO-OPTIC EFFECT DEVICE

KENJI KAWASHIMA, KENZO FUJIWARA, KIKUO KOBAYASHI (ATR Optical and Radio Communications Laboratories, Kyoto, Japan), and NAOKATSU SANO (Kwansei Gakuin University, Nishinomiya, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 3B, March 1, 1992, p. L214-L216. refs

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Bistable operation of an asymmetric self-electrooptic effect device (A-SEED) which consists of a GaAs/AlAs superlattice and an InGaAs/AlGaAs multiple quantum well is demonstrated. The A-SEED is driven by two illuminations with widely separated wavelengths, one of which is transparent to the GaAs substrate. Advantages of the A-SEED for applications to optically bistable transmission devices are discussed with emphasis on negligible crosstalk between the signal beam and the control beam. Author

A92-40212

ALGAAS-GAAS PNP DIFFERENTIAL OPTICAL SWITCH

KUNIIHIKO HARA, KEISUKE KOJIMA, KAZUMASA MITSUNAGA, and KAZUO KYUMA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 5, May 1992, p. 1335-1342. refs

Copyright

A differential optical switch based on parallel-connected AlGaAs-GaAs npn structures is presented. With continuous input light two optical inputs with the power difference of as low as 0.1 nW were discriminated. The minimum operating energy with pulse inputs was 400 fJ. With introduction of a storage operation of npn structures, the optical S-R flip-flop operation is also demonstrated with a 7.2 pJ optical input energy. Its expansibility of 2D array is attractive in optical parallel processing systems, especially in optical neural networks. Author

A92-40932

OPTICAL COMPUTING; PROCEEDINGS OF THE 1990 INTERNATIONAL TOPICAL MEETING, KOBE, JAPAN, APR. 8-12, 1990

JUMPEI TSUJIUCHI, ED. (Chiba University, Japan), YOSHIKI ICHIOKA, ED. (Osaka University, Suita, Japan), and SATOSHI ISHIHARA, ED. (Electrotechnical Laboratory, Tsukuba, Japan)

Meeting sponsored by Japan Society of Applied Physics, International Commission for Optics, Optoelectronic Industry and Technology Development Association, et al. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings, Vol. 1359), 1990, 451 p. No individual items are abstracted in this volume.

(SPIE-1359; ISBN 4-980813-37-9) Copyright

The present conference on optical computing discusses advancements in the fields of optical materials and devices, spatial light modulators (SLMs), optical computing systems, optical neural computing and interconnections, optical phenomena, optical computing for image processing, and optical interconnections. Attention is given to optically addressed SLMs, an optically addressed liquid crystal light valve, implementation of optical ternary logic with a twin-stripe laser diode, holographic symbol substitution with a joint transform correlator, acoustooptic digital multiplication by analog convolution, reconfigurable optical interconnection via photorefractive holograms, and the optical implementation of a Hopfield associative memory. Also discussed are an optoelectronic computer architecture for binary image algebra, a shift/rotation/scale-invariant optical associative memory, applications of bipolar morphology, an integrated optical array illuminator, an adaptive optical pattern classifier, and an integrated optical array illuminator. O.C.

A92-42395

FABRICATION AND EVALUATION OF X-RAY MULTILAYER MIRRORS PREPARED BY LASER-INDUCED CHEMICAL VAPOR DEPOSITION

MASATAKA SHIN-OGI (Seiko Instruments, Inc., Matsudo, Japan), SHOJI SEKI (Nitto Denko Corp., Ibaraki, Japan), YUKINOBU ISHINO, HIROSHI NAGATA, and YOSHIHIKO SUZUKI (Nikon Corp., Shinagawa, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1219-1224. refs

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This study demonstrates a new preparation process for fabricating X-ray multilayer mirrors. Tungsten/carbon multilayer mirrors were prepared using laser-CVD. The structure and properties of the mirror were examined using X-ray diffraction, synchrotron radiation, and TEM measurements. The reflectivity at a grazing angle of 14.5 deg was observed to be 4.1 percent at a wavelength of 5 nm. The reflectivity was lower than the ideal reflectivity. The reduction in the reflectivity was caused by the lower-density film (tungsten layer), interface roughness and diffuse interfaces. Furthermore, after annealing at room temperature for two months, the increment of the period of this mirror was about 33 percent. This was due to the oxidation of tungsten films in W/C (tungsten/carbon multilayer mirror). Author

A92-42453

HIGH-FREQUENCY FIBER-OPTIC PHASE MODULATOR USING PIEZOELECTRIC POLYMER COATING

M. IMAI, T. YANO, and Y. OHTSUKA (Hokkaido University, Sapporo, Japan) IN: High-frequency analog fiber optic systems; Proceedings of the Meeting, San Jose, CA, Sept. 17, 18, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1991, p. 13-20. refs

Copyright

High-frequency response (about 50 MHz) is reported for a fiber-optic phase modulator that is coated with vinylidene fluoride/trifluoroethylene (VDF/TrFE) copolymer, 80 about 90 microns thick, on a single-mode fiber of 80 microns diameter and made piezoelectric by radial poling. A flat response of optical phase shifts is observed in the frequency range over 10 KHz to 3 MHz whereas at frequencies higher than 4 MHz it shows multiple peaks dominated by radial resonances of the fiber-jacket composite. An excellent agreement exists between the experimental data and theoretical calculations based on radial vibration analysis. Author

A92-45961

DISPERSION AND RADIATION LOSS CHARACTERISTICS OF ANTIRESONANT REFLECTING OPTICAL WAVEGUIDES - NUMERICAL RESULTS AND ANALYTICAL EXPRESSIONS

TOSHIHIKO BABA (Tokyo Institute of Technology, Yokohama, Japan) and YASUO KOKUBUN (Yokohama National University, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 7, July 1992, p. 1689-1700. Research supported by Nippon Sheet Glass Foundation for Material Science. refs (Contract MOESC-63460139; MOESC-63790296) Copyright

The numerically calculated propagation characteristics of ARROW (Antiresonant Reflecting Optical Waveguide) and ARROW-B, new single-mode slab waveguides fabricated on a semiconductor substrate, are presented. The approximate expressions that provide their fundamental design condition are given. Various ARROW-type structures are introduced along with their usable materials. The numerically obtained dispersion and radiation loss characteristics of modes in ARROW are shown. It is found that the ARROW modes are leaky ones into which the first cladding modes are transformed at their cutoffs. Approximate expressions for the propagation constant and radiation loss are obtained. The expression for beta suggests that it can be controlled easily and precisely, and the expression for alpha suggests that it can be reduced by the large index difference between the core and first cladding. The propagation characteristics and their approximate expressions for ARROW-B are also presented. C.D.

A92-45964

HIGH-SPEED ELECTROOPTIC DEFLECTOR AND ITS APPLICATION TO PICOSECOND PULSE GENERATION

BONG Y. LEE, TETSURO KOBAYASHI, AKIHIRO MORIMOTO, and TADASI SUETA (Osaka University, Toyonaka, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 7, July 1992, p. 1739-1744. refs Copyright

This paper describes new types of electrooptic deflectors with high speed and high efficiency, which are useful for ultrafast optical switching and ultrashort optical pulse generation. These deflectors are driven by an X band standing wave along the microstrip line on an electrooptic crystal. A time-varying spatial slope of refractive index is induced in the crystal by the electric standing wave. As a result, the ultrafast deflection is carried out. It is confirmed experimentally the operation of such deflectors constructed on a LiTaO₃ crystal using a 514.5 nm CW argon laser and a 9.35 GHz driving frequency. In addition, the optical pulse compression from CW to 9.35 GHz-16 ps was carried out with a diffraction grating and picking out 18.7 GHz-8 ps pulse train was also carried out using a slit as a temporal window. Author

A92-48256

OPTICAL BISTABILITY ASSOCIATED WITH SURFACE PLASMON POLARITON EXCITATION

TOSHIHIRO OKAMOTO, MASANOBU HARAGUCHI, and MASUO FUKUI (Tokushima University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1549-1555. refs Copyright

Optical bistability due to excitation of surface plasmon polaritons (SPPs) and long-range SPPs is analyzed for two uniaxial approximations in prism/metal film/nonlinear optic medium and prism/gap material/metal film/nonlinear optic medium samples where the nonlinear optic medium has an intensity-dependent refractive index. The nonlinearity along the normal to the interface is found to be reasonably low. C.D.

A92-48276

APPLICATION OF DIFFRACTION THEORY TO TELESCOPE OPTICS

AKIHIKO MIYASHITA and HIROYASU ANDO Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 3, 1992, p. 385-397.

Based on the diffraction theory derived from the principle of

Huygens-Fresnel, the realistic energy distribution (or Point Spread Function) at the focal plane of the telescope optics has been calculated. This method is very useful to make a final answer or a final acceptance check to the optical performance of telescope optics. Some applications of this calculation to the telescope optics are presented. Author

A92-48343

EFFICIENT SECOND-HARMONIC GENERATION WITH A SLAB WAVEGUIDE COMPOSED OF PERIODICALLY CORONA-POLED ORGANIC COPOLYMER

YUJI AZUMAI (National Defense Academy, Yokosuka, Japan), MANABU KISHIMOTO (Mitsubishi Petrochemical Co., Ltd., Advanced Materials Laboratory, Ibaraki, Japan), and HEIHACHI SATO (National Defense Academy, Yokosuka, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1358-1364. refs Copyright

Using the slab waveguide composed of spin-coated vinylidene cyanide/vinyl acetate (VDCN/VAC) organic copolymer having the square-shaped corrugation of nonlinear optical susceptibility $\chi^{(2)}$ with corona discharge in the guiding layer, and taking quasi-phase matching between the dominant modes of both fundamental and second-harmonic waves, enhancement of second-harmonic generation (SHG) has been demonstrated at Nd:YAG 1.06 micron and Er:YAG 2.94 micron laser lines. The SHG power with this $\chi^{(2)}$ corrugated slab guide is theoretically evaluated, together with its enhancement factor (E.F.) to a bulk scheme. The E.F. of 500 to 800 obtained in the experiments is consistent with the theoretical estimates. Author

A92-48345

INFLUENCE OF GROWTH TEMPERATURE ON THE MAGNETIC AND OPTICAL PROPERTIES OF LIQUID-PHASE-EPITAXIAL(LPE)-GROWN LANTHANUM- AND GALLIUM-SUBSTITUTED YTTRIUM IRON GARNET ((LA, GA):YIG) FILMS AND THEIR APPLICATION TO WAVEGUIDES

NAOTO SUGIMOTO, AKIYUKI TATE, SHINJI MINO, and ATSUSHI SHIBUKAWA (NTT, Opto-Electronics Laboratory, Tokai, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1372-1377. refs Copyright

The growth temperature dependence is measured of the magnetic and optical properties of lanthanum- and gallium-substituted yttrium iron garnet films deposited on gadolinium gallium garnet substrates by the liquid-phase-epitaxial-growth method for use as integrated optical waveguides. The magnetization of the film can be saturated in the film plane by a weak external-magnetic field. The refractive index is controlled in a range of 2.192 to 2.204 by the growth temperature, which ranges from 893 to 835 C. Rib waveguides with low propagation loss are also fabricated. Author

A92-49603

INTEGRATION OF FREE-SPACE INTERCONNECTS USING SELFOC LENSES - IMAGE TRANSMISSION PROPERTIES

KENJIRO HAMANAKA (Nippon Sheet Glass Co., Ltd., Tsukuba Research Laboratory, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1656-1662. refs Copyright

A novel optical interconnection system which consists of cascade arrays of Selfoc lenses, has been proposed. An alignment-free optical mother board which has many conjugate image planes and the Fourier planes composed by the lenses is available for integrating many kinds of free-space optical systems. The system has the advantages of easy assembly and high reliability, in addition to a large space-bandwidth product and flexibility. Its concept, optical designs and image transmission properties evaluated through basic experiments and ray tracing estimations, are discussed. Author

A92-49604

TWO-DIMENSIONAL OPTICAL BUSES FOR MASSIVELY PARALLEL PROCESSING

SHIGERU KAWAI (NEC Corp., Opto-Electronics Research Laboratories, Kawasaki, Japan) and MASANORI MIZOGUCHI (NEC Corp., C&C Information Technology Research Laboratories, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1663-1665. refs

Copyright

Optical interconnections using two-dimensional waveguides are presented. Light beams whose incident angles are greater than the critical angle of a waveguide can propagate within that waveguide, which behaves as an optical bus. Such optical buses are suitable for massively parallel processing because they have a large number fan-outs and no skew. Estimated propagation distance in the waveguides is roughly 500 mm. One to several hundred interconnections may be achieved. Glass plates with concave lenses are used to demonstrate bus operations. Author

A92-49605

PARALLEL OPTICAL WALSH EXPANSION IN A PATTERN RECOGNITION PREPROCESSOR USING PLANAR MICROLENS ARRAY

KIMIO MURASHIGE, ATSUSHI AKIBA, TOSHIHIKO BABA, and KENICHI IGA (Tokyo Institute of Technology, Yokohama, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1666-1671. refs

Copyright

A parallel optical processor developed for a pattern recognition system using a planar microlens array and a Walsh orthogonal expansion spatial filter is developed. The parallel optical Walsh expansion of multiple images made by the planar microlens array with good accuracy, which assures 99-percent recognition of simple numeral characters in the system, is demonstrated. A novel selection method of Walsh expansion coefficients is proposed in order to enlarge the tolerance of the recognition rate against the deformation of input patterns. P.D.

A92-49607

OPTICAL LEARNING NEURAL NETWORK USING SELFOC MICROLENS ARRAY

YOSHIO HAYASAKI, ICHIRO TOHYAMA, TOYOHICO YATAGAI (Tsukuba, University, Japan), MASAHICO MORI, and SATOSHI ISHIHARA (Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5B, May 1992, p. 1689-1693. refs

Copyright

The study proposes an optical network system with learning capabilities and a 2D architecture. This architecture is implemented by a multiple imaging system of Selfoc microlens arrays, which makes it possible to develop a compact optical neural network system. Synaptic weights of neurons are memorized in a Pockels readout optical modulator and the system obtains the learning capabilities. Experimental verification of multiple imaging and learning is presented. In the experiments, the neural network system stores the three patterns by an orthogonal learning method. The performance of the optical neural network system is evaluated in terms of a point spread function of the Selfoc microlens. P.D.

A92-49763

OPTICAL CHIP IMPLEMENTATION OF CELLULAR AUTOMATA

SENMAO LIN, ITSUO KUMAZAWA (Tokyo Institute of Technology, Japan), and JIE WU (Tokyo: University, Japan) Microwave and Optical Technology Letters (ISSN 0895-2477), vol. 5, no. 10, Sept. 1992, p. 493-496. refs

Copyright

An optoelectronic chip implementation of a nine-site elementary cellular automaton based on a two-layer structure is described. All 256 cellular automaton local rules can be performed by simply programming an SLM mask. The system has a high parallel-processing capability, is easy to program, and is suitable for integration onto a single chip. L.M.

A92-49905

NEW SELF-ELECTRO-OPTIC EFFECT DEVICE USING TWO WAVELENGTHS IN INGAAS/ALGAAS MULTIPLE QUANTUM WELLS

STEPHEN GIUGNI, KENJI KAWASHIMA, KENZO FUJIWARA (ATR Optical and Radio Communications Research Laboratories, Kyoto, Japan), and NAOKATSU SANO (Kwansei Gakuin University, Nishinomiya, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 4, July 27, 1992, p. 376-378. refs

Copyright

A self-electrooptic effect device is proposed and demonstrated in an InGaAs/AlGaAs multiple-quantum-well diode structure by using different wavelengths for the signal and control wavelengths. The single-resistor-biased device exhibits optical transmission bistability between two stable states of the signal beam at λ_1 when the control beam power at λ_2 is varied. The two wavelengths λ_1 and λ_2 may be widely separated so that one is absorbed in the substrate and the other transmitted eliminating the need for substrate removal. The separate wavelengths also eliminate interference effects simplifying the design of vertical device arrays enhancing the possibility of system integration. Author

A92-49910

ENHANCED SECOND-ORDER OPTICAL NONLINEARITY USING INTER- AND INTRA-BAND TRANSITIONS IN LOW-DIMENSIONAL SEMICONDUCTORS

AKIRA SHIMIZU (Research Development Corporation of Japan, Tokyo), MAKOTO KUWATA-GONOKAMI, and HIROYUKI SAKAKI (Tokyo, University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 4, July 27, 1992, p. 399-401. refs

Copyright

A novel scheme is proposed for enhancing $\chi^{(2)}$ (ω_3 ; $-\omega_1, \omega_2$) in asymmetric quasi-low-dimensional (QLD) semiconductors. The ω_1 and ω_2 are tuned to exciton levels, while $\omega_3 = \omega_2 - \omega_1$ is tuned to an intersubband transition energy. Fairly large $\chi^{(2)}$ is obtained when a certain asymmetry is introduced in the QLD structure by, e.g., an external electric field F . A possible application is the efficient down-conversion of coherent light emitted from a laser diode(s) into an intersubband frequency ω_3 via a parametric process or difference-frequency generation. It is also possible to modulate the intensity of the down-converted, long-wavelength light by modulating F at a very high frequency of several tens of GHz. Author

A92-49954

BREAKUP OF BOUND HIGHER-ORDER SOLITONS

STEPHEN R. FRIBERG and KENNETH W. DELONG (NTT, Basic Research Laboratories, Musashino, Japan) Optics Letters (ISSN 0146-9592), vol. 17, no. 14, July 15, 1992, p. 979-981. refs

Copyright

Bound higher-order solitons, sometimes called breather solitons, can easily be broken apart by small perturbations. The conditions for breakup of bound solitons are discussed, and a method to determine the details of the soliton breakup is described. Using this method, the breakup of bound solitons by optical filters, by asymmetric FM modulation (not AM or symmetric FM modulation), and by superposition with other optical pulses is illustrated. Author

A92-51025

THEORETICAL ANALYSIS OF CERENKOV-TYPE OPTICAL SECOND-HARMONIC GENERATION IN SLAB WAVEGUIDES

NAOKI HASHIZUME, TAKASHI KONDO, TOMOHIRO ONDA (Tokyo, University, Japan), NAGAATSU OGASAWARA (University of Electro-Communications, Chofu, Japan), SHINSUKE UMEGAKI (Tokyo Engineering University, Hachioji, Japan), and RYOICHI ITO (Tokyo, University, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 8, Aug. 1992, p. 1798-1815. Research supported by MOESC. refs

Copyright

Optical second-harmonic generation in the Cerenkov-radiation

scheme in slab waveguides has been theoretically investigated for all the possible type I configurations. By solving the nonlinear wave equations analytically, a simple general expression for the second-harmonic power has been obtained. Characteristics of the Cerenkov-type second-harmonic generation and optimum conditions for attaining high conversion efficiencies are discussed on the basis of the theoretical analysis. It is shown that, in order to attain high conversion efficiencies, off-diagonal elements of nonlinear optical coefficient tensor should be utilized taking advantage of birefringence. Author

A92-51113

APPLICATION OF PHASE-STABILIZED OPTICAL FIBER IN TRANSMISSION OF REFERENCE AND IF SIGNALS IN VLBI OBSERVATION

KATSUHIISA SATO, TADAYOSHI HARA, MITSUMI FUJISHITA, SEISUKE KUJI, SEITSU TSURUTA, YOSHIKI TAMURA, TETSUO SASAO, KOICHI SATO, and SEIJI MANABE (Mizusawa Astrogeodynamics Observatory, Japan) IEEE Transactions on Instrumentation and Measurement (ISSN 0018-9456), vol. 41, no. 3, June 1992, p. 385-389. refs
Copyright

A Phase-Stabilized Optical Fiber (PSOF) cable, which is 880 m long, is successfully used for the first time to transmit 100-520 MHz III VLBI observations. Phase stability of the 1760-m round-trip PSOF cable is measured by a dual mixer time difference system. Results of the measurements show that the stability of the PSOF cable system is about 50 times better than that of an ordinary coaxial cable system. The measured phase fluctuations are smaller than the tolerance limit required for a coherence loss of less than 2 percent in VLBI observations with an integration time of several hundred seconds. Internal accuracies of the international geodetic VLBI observations, in which the PSOF cable system is used at a station, are proven to be in the level of the present-day standard. The results show that the performance of the 880-m long PSOF cable is at least comparable with, and probably better than, that of coaxial cables of much shorter length widely used in VLBI stations. Author

A92-53790

MIRRORLESS MICROCAVITY SPONTANEOUSLY FORMED IN FERROELECTRIC LIQUID CRYSTALS

KOTARO KAJIKAWA, TADAAKI ISOZAKI, HIDEO TAKEZOE, and ATSUO FUKUDA (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6A, June 1, 1992, p. L679-L681. refs
Copyright

SHG from ferroelectric liquid crystals (FLC) as a function of helicoidal pitch is observed. Not only the transmitted but also the reflected SH intensities markedly increase when the wavelength of the SH light coincides with the optical pitch of the helicoid. This fact implies the existence of cavity action by FLC: the helicoidal structure confines the SH light generated inside. Author

A92-54441

NUMERICAL ACHIEVEMENT OF STRONG LOCALIZATION OF LIGHT IN OPTICAL WAVEGUIDES WITH APERIODIC GRATING

MOTOHIRO TAKANO, KOUSUKE YAKUBO, and TSUNEYOSHI NAKAYAMA (Hokkaido University, Sapporo, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L839-L842. Research supported by MOESC. refs
Copyright

It is shown through numerical simulations that light is strongly localized in optical waveguides with an aperiodic grating. The system presented is actually achievable by applying recent microfabrication methods. The results provide insight into the modeling and design of optical waveguides for observing the strong localization of light. R.E.P.

A92-54446

DISPERSION OF THE THIRD-ORDER NONLINEAR OPTICAL SUSCEPTIBILITY IN C60 CALCULATED WITH A TIGHT-BINDING MODEL

KIKUO HARIKAWA and SHUJI ABE (Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L887-L889. refs

Copyright

The frequency dependence of third harmonic generation (THG) in C60 is calculated, making use of a tight-binding model for π -electrons. The magnitudes of the THG, about 10 to the -12th esu, near zero frequency, agree with those in experiments for the low-energy region. The order of the magnitude, 10 to the -11th esu, around the three-photon resonance peak due to the lowest allowed excitation, recently measured by Meth et al. is explained. At higher energies, a large enhancement of the THG at 3-omega of about 6 eV as a result of double resonance enhancement is predicted. Author

A92-54453

CONVERSION EFFICIENCY ENHANCEMENT TECHNIQUE FOR A QUASIPHASE MATCHED SECOND-HARMONIC GENERATION DEVICE

KEISUKE SHINOZAKI, TAKESHI TAKAMORI, KENJI WATANABE, TOSHIKI FUKUNAGA, and TAKESHI KAMIJOH (Oki Electric Industry Co., Ltd., Research and Development Group, Hachioji, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2104-2108. refs
Copyright

Conversion efficiency enhancement techniques have been demonstrated for quasi-phase matched (QPM) second-harmonic generation (SHG). First, a technique is described for confining the high fundamental optical power density in a waveguide with a domain-inverted grating (SHG waveguide) (i.e., a technique for monolithic integration), the SHG waveguide, and a distributed Bragg reflector (DBR). A 40-percent increase in the conversion compared with a conventional device without a DBR was achieved under QPM conditions. Also described is a method of automatically satisfying QPM conditions, using a laser diode (LD) with antireflection-coated facets. The InP/InGaAsP LDs were used and it was confirmed that the LD oscillated at a wavelength satisfying the QPM conditions. The normalized conversion efficiency was 4.1 percent/W per sq cm. Author

A92-54454

EVALUATION OF HIGH-EFFICIENCY LINBO3 OPTICAL PHASE MODULATOR USING ELECTRODES BURIED IN THE BUFFER LAYER

HIROSHI MIYAMOTO, HIROSHI OHTA, KAZUHIKO TABUSE, and YOSHIHIDE MIYAGAWA (Optical Measurement Technology Development Co., Ltd., Musashino, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2116-2119. refs
Copyright

A novel 3D high-efficiency LiNbO3 optical phase modulator is proposed, which is comprised of electrodes buried in the buffer layer, making it possible to match the microwave electric field with the optical electric field. The waveguide was fabricated on Z-cut LiNbO3 by diffusion of an 8-micron-wide and 90-nm-thick titanium strip at 1010 C. The results of evaluation of this modulator are presented. I.S.

A92-54455

PARALLEL NEIGHBORHOOD OPERATION SYSTEM BY OPTICAL PARALLEL LOGIC GATE AND OPTICAL INTERCONNECTION WITH PRISMS

KENJI UYEYAMA and TAKUMI MINEMOTO (Kobe University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2126-2132. refs
Copyright

A system which can perform iterative parallel neighborhood operations is described. The system consists of an optical parallel

logic gate, a simple multiple-imaging system, and electronic feedback circuits. The operation of the system is demonstrated by performing simple binary image processings, including dilation, erosion, edge detection, local pattern matching, and corner detection (for which a new algorithm is proposed). I.S.

A92-55989

PIEZOELECTRICALLY INDUCED OPTICAL PHASE MODULATION OF LIGHT IN SINGLE-MODE FIBERS

MASAAKI IMAI (Muroran Institute of Technology, Japan), TAKASHI YANO (Toshiba Corp., Hino Works, Japan), KAZUSHI MOTOI, and AKIRA ODAJIMA (Hokkaido Institute of Technology, Sapporo, Japan) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 9, Sept. 1992, p. 1901-1908. Research supported by Suhara Memorial Foundation, KDD Engineering and Consulting Foundation, and MOESC. refs

Copyright

Optical phase modulation induced in piezoelectric copolymer, vinylidene fluoride (73 mol pct)/trifluoroethylene (27 mol pct), coated single-mode fibers has been examined and analyzed from both experimental and theoretical aspects. High-sensitive phase modulation, which is more than four times as large as those of vinylidene fluoride/tetrafluoroethylene copolymer, is obtained over a flat response range from 10 KHz to 3 MHz. At frequencies below 7 KHz and higher than 6 MHz the optical responses are dominated by axial and radial resonances, respectively, of the fiber-jacket composite. The theoretical prediction of induced phase shifts at high frequencies is carried out based on radial vibration analysis and followed by the experimental results. Author

N92-10640# Argonne National Lab., IL.

OPTICAL SIGNAL MULTIPLEXER AND DEMULTIPLEXER

HIDEO TSUBATA, NOBUAKI OHARU, and KIYOSHI SASHIDA 18 Dec. 1990 5 p Transl. into ENGLISH of Japanese Patent No. 60-60605, (8 Apr. 1985) (Contract W-31-109-ENG-38) (DE91-017836; ANL-TRANS-90-19) Avail: CASI HC A01/MF A01

An optical signal multiplexer and demultiplexer are described. A single optical receptor or emission diode is positioned facing the lens surface of a condenser lens at the focal point of said lens. Multiple collimator lens, which make parallel rays incident to the condenser lens or entrap parallel rays from the condenser lens, is positioned facing the respective condenser lens, noted above, on the side of said condenser lens opposite the above-noted light receptor or emission diode. At the focus spot of each collimator lens, another light emission or receptor diode, which faces the corresponding collimator lens, is positioned individually relative to its respective positions. DOE

N92-13791# Gordon Research Conferences, Inc., Kingston, RI. GORDON RESEARCH CONFERENCE ON HOLOGRAPHY AND OPTICAL INFORMATION PROCESSING Final Technical Report, 15 May - 15 Nov. 1991

JOHN F. WALKUP 9 Sep. 1991 13 p Conference held in Plymouth, NH, 17-21 Jun. 1991 (Contract AF-AFOSR-0186-91; AF PROJ. 2305) (AD-A241615) Avail: CASI HC A03/MF A01

The 1991 Gordon Research Conference on Holography and Optical Information Processing was held on 17-21 June, 1991 at Plymouth State College in Plymouth, NH. The talks on Ultrafast Optical Logic Using Solitons and Optical Processing with Planar Optics pointed out the significant progress being made by various Bell Labs investigators on various aspects of optical computing. Professor Sing Lee from the University of California-San Diego gave an excellent overview of some engineering and performance issues in optoelectronic computing. It is clear that the Soviets have made considerable progress on multi transducer acousto-optic spectrum analyzers. It is also clear that the Japanese government is planning to continue to make optical computing one of its high priority areas, with its NIPT (New Information Processing Technology project), and are projected to continue to investigate so called sixth generation computer technologies. GRA

N92-18303# National Aerospace Lab., Tokyo (Japan). Thermofluid Dynamics Div.

THE INFLUENCE COEFFICIENT MATRIX FOR SIZE MEASUREMENTS OF FINE PARTICLES BY POLARIZED SCATTERING INTENSITY PATTERN ANALYSIS [HENKO SANRAN KYODO PATAN KAISEKI NIYORU BISHO RYUSHIGUN NO RYUDO SOKUTEI NOTAMENO EIKYO KEISU GYORETSU]

SHIGERU HAYASHI Jun. 1989 15 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-606; JTN-92-80243) Avail: CASI HC A03/MF A01

In the past, the diffraction method has been used to measure particle diameter. However, this method is ineffective when the particle size is of the same order as the light wavelength, due to the influence of polarization by scattering light. In such cases, polarized scattering intensity pattern analysis enables determination of the particle size because the intensity of the polarized element increases in accordance with the particle size. For this type measurement, the influence coefficient matrix, which relates the scattering light energy on each sensor and particle size, is used. This paper presents the influence coefficient matrix, which is solved by Mie scattering function program, for analysis on a personal computer. Author (NASDA)

N92-25623#

Japan Resources Observation System Organization.

DEVELOPMENT STATUS OF JERS-1 OPTICAL SENSOR SYSTEM

HIROMI ONO In NASDA, International Conference on Japanese Earth Observation Programs: JERS-1 Workshop p 19-28 2 Nov. 1990

(EW-3) Avail: CASI HC A02/MF A02

Presented in viewgraph format, the status of optical sensor system development for JERS-1 (Japan Earth Resources Satellite-1) is outlined. Topics addressed include: specification of OPS (Optical Sensor); block diagram of JERS-1 OPS; configuration of OPS; system of stereoscopic imaging; configuration of VNIR (Visible and Near-Infrared Radiometer); CCD (Charge Coupled Device) sensor; configuration of SWIR (Short Wave Infrared Radiometer); and development schedules. Author (NASDA)

75

PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

A92-10399

AN INVESTIGATION OF PRODUCT DISTRIBUTIONS IN MICROWAVE PLASMA FOR DIAMOND GROWTH

T. MITOMO, T. OHTA, E. KONDOH, and K. OHTSUKA (Kawasaki Steel Corp., Technical Research Div., Chiba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Oct. 15, 1991, p. 4532-4539. refs

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Product distributions in the microwave plasmas of various source gases were determined using in situ FTIR spectroscopy. An equilibrium among CH₄, C₂H₂, and C₂H₄ is maintained in plasmas of CH₄ + H₂, C₂H₂ + H₂, and C₂H₄ + H₂. In plasmas of CH₃OH + H₂ and C₂H₅OH + H₂, the parent molecules were decomposed and CH₄, C₂H₂, C₂H₄, and CO were detected. In CCl₄ + H₂ plasma, the parent molecule was also decomposed, and CH₄, C₂H₂, C₂H₄, and HCl were detected. In CO + H₂ plasma, CH₄ and C₂H₂ were detected. The addition of O₂ to the CH₄ + H₂ plasma reduced the concentrations of CH₄ and C₂H₂ in the plasma. These findings provide a new explanation for the production of diamond films from various kinds of gas mixtures and for the fact that the C/H₂ ratio in the source gas mixture is an important parameter for determining the quality of diamond films. C.D.

A92-12193

SCATTERING OF A PLANE ELECTROMAGNETIC WAVE FROM MAGNETIZED CYLINDRICAL PLASMA. IV

SHUN-ICHI MATSUMOTO, HIROKO UEDA, and TAKASHI OKUZAWA University of Electro-Communications, Bulletin (ISSN 0915-0935), vol. 3, Dec. 1990, p. 261-267. In Japanese. refs

The conjugate gradient-fast Fourier transform (CG-FFT) method, an iterative technique, has been used for solving numerically the electric field integral equation that appears in the problems of electromagnetic wave scattering as well as antenna radiation. In this paper, the CG-FFT method is applied to the problem of electromagnetic wave scattering from a lossy, inhomogeneous and magnetized plasma cylinder, and show some numerical results of the echo width and the absorption power density. Author

A92-13462

DISSIPATIVE STRUCTURE IN PLASMA TURBULENCE

MITSUHIRO NAMBU, TOHRU HADA (Kyushu University, Fukuoka, Japan), S. N. SARMA, and S. BUJARBARUA (Institute of Advanced Study in Science and Technology, Guwahati, India) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Sept. 1991, p. 3004-3014. refs

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A new enhanced radiation process from plasma turbulence (plasma-maser) is interpreted as 'dissipative structure' in plasma turbulence. The plasma-maser process is effective in an open plasma system where some of the input energy is dissipated as anomalous radiation. The validity of the linear response theory which neglects the ensemble averaged second order electric field is given under the random phase approximation. The ordinary mode growth rate in the presence of the enhanced stationary Langmuir turbulence is obtained and the results have potential importance to clarify the mechanism of the anomalous radiation in plasma astrophysics. Author

A92-16469

LARGE EDDY SIMULATION OF MAGNETOHYDRODYNAMIC TURBULENT CHANNEL FLOWS UNDER A UNIFORM MAGNETIC FIELD

YUTAKA SHIMOMURA (Tokyo, University, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 3, Dec. 1991, p. 3098-3106. refs

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Magnetohydrodynamic turbulent channel flows under a uniform magnetic field are studied by using a large eddy simulation technique. The effect of a uniform magnetic field is incorporated into the subgrid-scale model in the form of a local damping factor. Compared with the experiment, this model is shown to work better than the usual Smagorinsky model in both turbulent and laminar states. This model predicts the detailed structures of the present flows, for which, one-point global turbulence models of ensemble mean type are helpless. Author

A92-17017

COMPUTER SIMULATIONS OF FIELD-ALIGNED CURRENTS GENERATED BY FAST MAGNETIC RECONNECTION IN THREE DIMENSIONS

M. UGAI (Ehime University, Matsuyama, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 96, Dec. 1, 1991, p. 21,173-21,181. refs

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A92-17938

VELOCITY SPACE DIFFUSION DUE TO RESONANT WAVE-WAVE SCATTERING OF ELECTROMAGNETIC AND ELECTROSTATIC WAVES IN A HOMOGENEOUS MAGNETIZED PLASMA

REIJI SUGAYA (Ehime University, Matsuyama, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Oct. 1991, p. 3367-3385. refs

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The velocity space diffusion equation which describes distortion of the velocity distribution function due to resonant wave-wave

scattering of electromagnetic and electrostatic waves in a homogeneous magnetized plasma is derived from the Vlasov-Maxwell equations by perturbation theory. The velocity space diffusion coefficient and the nonlinear wave-wave coupling coefficient which are expressed by three-order tensors in the rotating and Cartesian coordinates are transformed into simple and convenient forms in the Cartesian coordinates. By electrostatic approximation, the kinetic equations can also be applicable to the case where the three waves are electrostatic altogether or partially electrostatic. The conservation laws for total energy and momentum densities of waves and particles are verified. Author

A92-18935

LASER-ASSISTED PROBING METHOD FOR MEASURING NEGATIVE IONS IN PLASMAS

HIROSHI AMEMIYA and TAKANORI SUZUKI (Institute of Physical and Chemical Research, Wako, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1895-L1898. Research supported by MOESC. refs

Copyright

A laser beam is focused on a position in a plasma and electrons photodetached from negative ions are detected by a probe. The probe potential for obtaining an optimum signal intensity is slightly below the voltage that causes the sheath breakdown. The signal-to-noise ratio is increased more than in the case where the signal is detected either from the anode or the cathode. Spatial resolution is obtainable to the order of the laser beam diameter. Author

A92-19582

BEAT-WAVE EXCITATION OF PLASMA WAVE AND OBSERVATION OF ACCELERATED ELECTRONS

Y. KITAGAWA, T. MATSUMOTO, T. MINAMIHATA, K. SAWAI, K. MATSUO, K. MIMA, K. NISHIHARA, H. AZECHI, K. A. TANAKA, H. TAKABE (Osaka University, Suita, Japan) et al. Physical Review Letters (ISSN 0031-9007), vol. 68, Jan. 6, 1992, p. 48-51. refs

Copyright

The simultaneous observations of a beat-wave-excited plasma wave and of energetic electrons are reported. A plasma wave is excited when the beat-wave frequency of a laser with two wavelengths of 10.6 and 9.57 microns equals the plasma frequency. The Stokes sideband measurement gives a wave amplitude of about 5 percent. Plasma electrons with the energies of more than 10 MeV are observed at the resonant density. Author

A92-21237

TURBULENT DYNAMO EFFECT AND CROSS HELICITY IN MAGNETOHYDRODYNAMIC FLOWS

FUJIHIRO HAMBA (Tokyo, University, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, Feb. 1992, p. 441-450. Research supported by MOESC. refs

Copyright

A three-dimensional direct simulation of inhomogeneous magnetohydrodynamic (MHD) turbulence is carried out to investigate the turbulent dynamo effect. The velocity field is driven by an external force so that the velocity and magnetic fields are statistically inhomogeneous in one direction and homogeneous in the other two directions. Several statistical quantities are obtained such as the mean magnetic field, the turbulent energy, and the turbulent electromotive force. The data are used to examine the modeling of the dynamo effect in the four-equation turbulence model. It is shown that the dynamo term related to the cross helicity is more important than the well-known alpha-dynamo term. Some model constants in the four-equation model are estimated using the least-square method. Author

A92-21338

MAGNETOHYDRODYNAMIC BOUNDARY LAYER FLOW OVER A ROTATING DISK

TAKASHI WATANABE (Iwate University, Morioka, Japan) and TOSHIO OYAMA Zeitschrift fuer angewandte Mathematik und

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Mechanik (ISSN 0044-2267), vol. 71, no. 12, 1991, p. 522-524. refs

Copyright

The boundary layer flow of a rotating electrically conducting fluid on a rotating disk in the presence of a magnetic field is considered. The governing similarity equations are numerically solved using a finite-difference scheme. Numerical results are given for the velocity profiles and the displacement thickness for various values of the magnetic parameter. C.D.

A92-22327

MONTE CARLO SIMULATION STUDY OF CRYSTALLIZATION IN RAPIDLY SUPERCOOLED ONE-COMPONENT PLASMAS

SHUJI OGATA (Tokyo, University, Japan) Physical Review A (ISSN 1050-2947), vol. 45, Jan. 15, 1992, p. 1122-1134. Research supported by MOESC. refs

Copyright

A Monte Carlo (MC) simulation method is presently used to study the development of solidification processes in rapidly supercooled one-component plasmas, giving attention to the evolutions of both interparticle correlations and of local and extended bond-orientational disorders. Layered structures emerge at prenucleation stages in the system, expediting subsequent evolution into bcc, monocrystalline metastable states with an admixture of intralayer interstitial defects; these differ significantly from glassy states obtained in previous simulations conducted with fewer particles. The roles of the number of MC particles and of MC periodic boundary conditions in the freezing transitions are discussed. O.C.

A92-22328

PLASMA-WAVE RESONATOR FOR PARTICLE-BEAM ACCELERATION

K. NAKAJIMA (National Laboratory for High Energy Physics, Tsukuba, Japan) Physical Review A (ISSN 1050-2947), vol. 45, Jan. 15, 1992, p. 1149-1156. refs

Copyright

It is shown that a large-amplitude plasma wave is resonantly excited by the round-trip propagation of a short laser pulse in a plasma. The scheme results in a resonator of plasma waves that is useful for accelerating a charged particle beam. This method can be used in order to avoid wave saturation due to detuning resulting from large-amplitude nonlinear oscillation. Author

A92-24607

DIGITALIZED TRIPLE-PROBE SYSTEM FOR THE DIRECT DISPLAY OF ELECTRON TEMPERATURE IN A TIME-VARYING PLASMA

SHOSAKU MATSUMURA (Musashi Institute of Technology, Tokyo, Japan), ALEX A. BEREZIN, and JEN-SHIH CHANG (McMaster University, Hamilton, Canada) Review of Scientific Instruments (ISSN 0034-6748), vol. 63, Feb. 1992, p. 1783-1787. Research supported by NSERC and MOESC. refs

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A technique for instantaneous linear digitalization of plasma electron temperature display using a triple-probe method is presented. A digitalized feedback is introduced between the floating probe voltage and the voltage applied to the other probes which is proportional to the electron temperature. Transfer of digitalized data by a photocoupler is used to suppress the side current which causes serious error on a triple-probe method. The results show that the measured electron temperatures are in a fairly good agreement with a Langmuir single-probe data. Present system can be applied to most of a low-density plasma when the ratio (probe radius/Debye length) is less than 2 for a wide range ratios of (mean-free path/probe radius). Detail error estimation is conducted for the orbital motion limited conditions. Author

A92-26513

RANGE OF APPLICATION FOR ASYMMETRIC DOUBLE PROBES

HIROSHI AMEMIYA (Institute of Physical and Chemical Research, Wako, Japan) and GERHARD FUCHS (Kernforschungsanlage

Juelich GmbH, Institut fuer Plasmaphysik, Federal Republic of Germany) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3531, 3532. Research supported by MOESC. refs

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Current-voltage characteristics of asymmetric double probes have been measured in hydrogen plasmas. It has been found that up to a critical ratio of the areas, a part of the probe characteristic in the neighborhood of zero voltage is symmetric with respect to a symmetric point. Above that critical ratio, the characteristic approaches that of a single probe. The true single probe characteristic can be obtained only if the area ratio is much larger than the above critical value. Author

A92-26678

POINT VORTEX MODEL OF A MODON SOLUTION

CHIIHIRO MATSUOKA and KAZUHIRO NOZAKI (Nagoya University, Japan) Physics of Fluids B (ISSN 0899-8221), vol. 4, March 1992, p. 551-558. refs

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An exact point vortex solution corresponding to the modon solution of the Hasegawa-Mima equation is presented and a new modulated point vortex model is introduced. In the framework of this model, the linear stability of a modon and modon-modon collisions are analyzed, and the frequency and position shift before and after the collision are estimated. Author

A92-26684

ON STABILITY OF STRONGLY NONLINEAR PLASMA OSCILLATIONS

T. HADA and M. NAMBU (Kyushu University, Fukuoka, Japan) Physics of Fluids B (ISSN 0899-8221), vol. 4, March 1992, p. 757-759. refs

Copyright

The modulational instability of finite-amplitude, longitudinal, nonlinear plasma oscillations in a cold plasma is discussed. Stable and unstable regimes appear alternatively as the wave nonlinear parameter varies. A possible laboratory experiment that may confirm this result is suggested. Author

A92-30417

NOTABLE AMPLIFICATION OF SOLITONS THROUGH REFLECTION OF BEAM IONS

TADAO HONZAWA and MASAZO ARAKAWA (Utsunomiya University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, Jan. 1992, p. 15-18. refs

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Results are presented of observations in a plasma of considerable amplification of ion acoustic solitons through reflection of beam ions. The observations verified that strong interaction of ion acoustic solitons with resonant beam ions results in significant soliton amplification and noticeable deformation of the beam energy distribution. It is suggested that the reflected beam ions supply energy for the soliton amplification. P.D.

A92-33149* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

FORMATION AND STABILITY OF POLARIZATION SHEATHS OF A CROSS-FIELD BEAM

DONG S. CAI (Kobe University, Japan) and OSCAR BUNEMAN (Stanford University, CA) Physics of Fluids B (ISSN 0899-8221), vol. 4, April 1992, p. 1033-1046. refs

(Contract NAS8-35350)

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A simple description is presented for a pure ion sheath formed on one side and a pure electron sheath formed on the other side of a neutral plasma beam. Both the ion and the electron sheath are found to be one-dimensionally stable and two-dimensionally unstable in a mode known as magnetron, slipping stream, and diocotron. This mode connects with the Kelvin-Helmholtz instability in neutral matter. The analytical results are confirmed both qualitatively and quantitatively by numerical simulations. The

simulations help define the linear behavior of the long-wave instability generated in the electron (or ion) sheath, including a strong shear. V.L.

A92-36068
IONIZATION MECHANISM OF CESIUM PLASMA PRODUCED BY IRRADIATION OF DYE LASER

JUN YAMADA, KOHJI SHIBATA, YOSHIYUKI UCHIDA (Aichi Institute of Technology, Toyota, Japan), YOSHIKI HIOKI, and TOSHIO SAHASHI (Daido Institute of Technology, Nagoya, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 2A, Feb. 1992, p. 377-380. refs
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When a cesium vapor was irradiated by a dye laser which was tuned to the cesium atomic transition line, the number of charged particles produced by the laser radiation was observed. Several sharp peaks in the number of charged particles were observed, which corresponded to the atomic transition where the lower level was the 6P excited atom. The ionization mechanism of the laser-produced cesium plasma has been discussed. An initial electron is produced by laser absorptions of the cesium dimer. When the cesium density is high, many 6P excited atoms are excited by electron collisions. The 6P excited atom further absorbs the laser photon and is ionized through the higher-energy state. As the cesium vapor pressure increases, the resonance effect becomes observable. The 6P excited atom plays a dominant role in the ionization mechanism of the laser-produced cesium plasma. Author

A92-36945
DIFFERENTIAL CROSS SECTION FOR THE EXCITATION OF HYDROGENLIKE IONS FROM HE(+) TO C(5+) BY LOW-ENERGY-ELECTRON IMPACT

YU ZOU and TOSHIZO SHIRAI (Japan Atomic Energy Research Institute, Tokai) Physical Review A (ISSN 1050-2947), vol. 45, no. 9, May 1, 1992, p. 6902-6905. refs
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A92-37260
MODULATIONAL INSTABILITY OF RELATIVISTIC ION-ACOUSTIC WAVES IN A PLASMA WITH TRAPPED ELECTRONS

YASUNORI NEJOH (Hachinohe Institute of Technology, Japan) IEEE Transactions on Plasma Science (ISSN 0093-3813), vol. 20, no. 2, April 1992, p. 80-85. refs
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The association between the modified Korteweg-de Vries solitary wave and the modulationally unstable envelope solitary wave in a weakly relativistic unmagnetized plasma with trapped electrons is discussed. The effect of trapped electrons modifies the nonlinearity of the nonlinear Schrodinger equation and gives rise to the propagation of the modulationally unstable ion-acoustic solitary wave. The amplitude of the envelope solitary wave increases while the number of trapped electrons decreases. The velocity of the solitary wave decreases with increasing ionic temperature and increasing particle velocities. The ion oscillation mode, which satisfies the nonlinear dispersion relation, is also derived. The present theory is applied to explain recent space observations of the solar energetic particle flows in interplanetary space and of the energetic particle events in the earth's magnetosphere. Author

A92-37969
CASCADING BIFURCATIONS TO CHAOS IN A CURRENT-CARRYING ION SHEATH

MITSUO KONO, HISATOSHI NAKASHIMA, and AKIO KOMORI (Kyushu University, Kasuga, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 407-410. refs
 Copyright

A theoretical analysis is conducted to describe cascading bifurcations followed by the onset of chaos as it was observed in a current-carrying ion sheath. Specific attention is given to the

Child-Langmuir law of space-charge-limited current in a plane diode, and an equation is set forth to describe ion dynamics in an ion sheath. The expression follows the Child-Langmuir law for a large potential drop and can be solved to give the observed bifurcation sequences. C.C.S.

A92-38046
MACROSCALE PARTICLE SIMULATION OF EXTERNALLY DRIVEN MAGNETIC RECONNECTION

SADAYOSHI MURAKAMI and TETSUYA SATO (National Institute for Fusion Science, Nagoya, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 849-862. refs
 Copyright

Externally driven reconnection, assuming an anomalous particle collision model, is numerically studied by means of a 2.5 D macroscale particle simulation code in which the field and particle motions are solved self-consistently. Explosive magnetic reconnection and energy conversion are observed as a result of slow shock formation. Electron and ion distribution functions exhibit large bulk acceleration and heating of the plasma. Simulation runs with different collision parameters suggest that the development of reconnection, particle acceleration and heating do not significantly depend on the parameters of the collision model. Author

A92-38342
MOMENTUM SOURCE OF THE PLASMA MASER

MITSUHIRO NAMBU (Kyushu University, Fukuoka, Japan), S. N. SARMA, and K. K. SARMA (M.C. College, Barpeta, India) Physical Review A (ISSN 1050-2947), vol. 45, no. 10, May 15, 1992, p. 7456-7462. refs
 Copyright

The plasma maser, an interesting nonlinear process in plasma, is an effective means of energy upconversion in frequency from Langmuir turbulence to the electrostatic Bernstein mode. It is shown that the primary momentum and energy source of the plasma maser is the external magnetic field, which is not the case for the standard mode-mode coupling processes. For strongly magnetized plasma (Ω_e is not less than ω_{pe}), where Ω_e and ω_{pe} are the electron cyclotron frequency and the plasma frequency, respectively, the growth rate of the Bernstein mode arises from the polarization term. The growth rate is large in contrast to the previous ion-sound-turbulence case. These results have potential importance in the interpretation of anomalous radiation phenomena in astrophysical, laboratory, and fusion plasmas. Author

A92-40496
QUASIPERIODIC PERTURBATIONS FOR THE ALFVEN-WAVE CONTINUOUS SPECTRA

ZENSHO YOSHIDA (Tokyo, University, Japan) Physical Review Letters (ISSN 0031-9007), vol. 68, no. 21, May 25, 1992, p. 3168-3171. refs
 (Contract MOESC-03680004)
 Copyright

A 2D periodic modulation of an ambient magnetic field generates a quasi-periodic perturbation for the Alfvén wave. A simple quasi-periodic wave equation is derived which resembles the Schrodinger equation for a valence electron in a one-dimensional quasi-crystal. Let σ be the tangent of the angle between the direction of the unperturbed magnetic field and the periodicity of the perturbation. If σ is an irrational number, the perturbed wave potential is quasi-periodic. By a large perturbation, the Alfvén continuum is changed into point spectra for almost all values of σ . Author

A92-44375
ARC TRANSITION AND GROWTH OF BIG-ARCS IN MAGNETOHYDRODYNAMICS GENERATOR CHANNELS

K. A. SATHEESH, Y. OKUMURA, and K. OKAZAKI (Toyohashi University of Technology, Japan) Journal of Thermophysics and

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Heat Transfer (ISSN 0887-8722), vol. 6, no. 3, July-Sept. 1992, p. 452-459. refs
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The arc transition in MHD generator channels from a low-current micro-arc mode to a high-current big-arc mode has been studied. An arc model, which considers the arc region to include an arc spot, an arc column, and a current spreading zone, has been proposed to obtain the critical parameters for such a transition. The model specifically aims at studying the possibilities for the occurrence of arcs that may extend up to, or beyond the thermal boundary layers, which has been reported in some experimental observations. The model predicts the critical values for the growth of such arcs, and were found to compare well with experimental observations. Author

A92-45457

A NUMERICAL STUDY ON THE CHARACTERS OF LASER-SUPPORTED DETONATION WAVE

TAKE OSHIMA and TOSHI FUJIWARA (Nagoya University, Japan) IN: International Pacific Air and Space Technology Conference and Aircraft Symposium, 29th, Gifu, Japan, Oct. 7-11, 1991, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1991, p. 891-902. refs
(SAE PAPER 912082) Copyright

The characteristics of laser-supported detonation (LSD) waves are studied numerically via a simulation in which four chemical reactions (elastic collision, inelastic collision, bremsstrahlung and inverse bremsstrahlung) are considered for simplicity. The propellant gas used is argon, while the source laser is CO₂ (wavelength = 10.6 microns). The problem is described by two governing equations: the laser intensity equation and the Euler equation. Once an LSD wave is formed, significant discontinuity appears at the shock front, so that several devices are required in order to delete the stiffness. The cutoff effect of a plasma is considered, and 'galloping' phenomena are simulated as a result. In this simulation of the LDS wave structure, the interaction between two waves and the effect of the plasma cutoff are analyzed. C.A.B.

A92-50972

BRIDGE FUNCTIONS AND IMPROVEMENT ON THE HYPERNETTED-CHAIN APPROXIMATION FOR CLASSICAL ONE-COMPONENT PLASMAS

HIROSHI IYETOMI, SHUJI OGATA, and SETSUO ICHIMARU (Tokyo, University, Japan) Physical Review A (ISSN 1050-2947), vol. 46, no. 2, July 15, 1992, p. 1051-1058. Research supported by Japan Society for the Promotion of Science and NSF. refs
(Contract MOESC-01460246) Copyright

Bridge functions, the neglected terms in the hypernetted-chain (HNC) theory of classical fluids, are extracted with high precision from Monte Carlo (MC) simulation data for classical one-component plasmas. The MC bridge functions are extended by the use of the exact short-range Widom expansion and of long-range boundary conditions arising from the compressibility sum rule. An explicit analytic expression for the bridge functions is then obtained, leading to improvement on the HNC scheme. Accuracy of the improved HNC scheme is confirmed through comparison with the MC results and by examination of the thermodynamic consistency. The extracted bridge functions are compared with those of other theoretical schemes. Author

A92-51843

OPERATING REGIONS OF A GAS-PUFF Z-PINCH AND ITS X-RAY RADIATION

KEIICHI TAKASUGI, ATSUSHI TAKEUCHI, HIROYUKI TAKADA, and TETSU MIYAMOTO (Nihon University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1874-1878. refs
Copyright

A z-pinch experiment is carried out with a hollow-shaped Ar gas puff. Three types of discharge are found depending on the delay time of discharge from gas-puff detection, and the pinch

time is compared with the measured gas pressure profile. Strong X-ray radiation is emitted from spots, a cloud and the anode surface. The number of spikes in the X-ray signal is correlated with spot images of the X-ray photograph. An X-ray burst is sometimes observed in the short-delay-time operation. Author

A92-51931

COMPARISON BETWEEN PARTICLE SIMULATION AND FULL-WAVE ANALYSIS FOR WAVE PROPAGATION IN A NONUNIFORM PLASMA

S. YAGITANI, I. NAGANO (Kanazawa University, Japan), Y. OMURA, and H. MATSUMOTO (Kyoto University, Uji, Japan) Radio Science (ISSN 0048-6604), vol. 27, no. 4, July-Aug. 1992, p. 449-462. Research supported by Kyoto University and CSK. refs
Copyright

Full-wave analysis has been applied to the study of wave propagation in a nonuniform plasma, especially where WKB approximation becomes invalid. Because of several approximations assumed, however, it cannot be applied to problems involving particle kinetic effects or nonlinear processes. To evaluate such complicated effects on wave propagation in a nonuniform plasma, particle simulations were performed with a 1D nonuniform electron plasma, in which a wave propagates parallel to the static magnetic field. Good agreement is found between the wave fields in the particle simulations and the full-wave solutions under the same plasma conditions. Particle simulation and full-wave analysis can be used together to characterize wave propagation under a fuller range of plasma conditions and to clarify the limitation of each. Author

A92-56570

DOUBLE LAYERS, SPIKY SOLITARY WAVES, AND EXPLOSIVE MODES OF RELATIVISTIC ION-ACOUSTIC WAVES PROPAGATING IN A PLASMA

YASUNORI NEJOH (Hachinohe Institute of Technology, Japan) Physics of Fluids B (ISSN 0899-8221), vol. 4, no. 9, Sept. 1992, p. 2830-2840. refs
Copyright

The fully relativistic ion fluid equations are used to show the formation of relativistic double layers, new spiky solitary waves, and explosive modes in an unmagnetized space plasma with hot ions. The solutions of these three modes are obtained from a mixed modified Kortweg-de Vries equation which includes the quadratic and the negative cubic nonlinearity. It is shown that the double-layer thickness narrows as the ion temperature and the relativistic effects increase. It was also found that, as the ion temperature increases, the potential drop of the double layer increases, as do the amplitudes of the spiky solitary wave; the explosive solution grows as the ion temperature effect increases. I.S.

A92-56572

COMPUTER STUDIES ON DEVELOPMENT OF THE FAST RECONNECTION MECHANISM FOR DIFFERENT RESISTIVITY MODELS

M. UGAI (Ehime University, Matsuyama, Japan) Physics of Fluids B (ISSN 0899-8221), vol. 4, no. 9, Sept. 1992, p. 2953-2963. refs
Copyright

Using computer simulations, the development of the fast reconnection mechanism for different resistivity models is investigated. The numerical results show that the reconnection process is strongly controlled by the resistivity model. Thus, for the uniform resistivity model, there is no indication of fast reconnection development. It is shown that the fast reconnection mechanism can rapidly build up and be sustained only when the resistivity is locally enhanced near an X-type neutral point in accordance with the global reconnection flow. I.S.

N92-10645# National Inst. for Fusion Science, Nagoya (Japan). **SINGLE PARTICLE AND FLUID PICTURE FOR THE PONDEROMOTIVE DRIFT IN NONUNIFORM PLASMAS**

B. BHATTACHARYYA, T. WATANABE, and KYOJI NISHIKAWA (Hiroshima Univ., Japan) Apr. 1990 14 p (ISSN 0915-633X) (NIFS-25) Avail: CASI HC A03/MF A01

General expressions for the ponderomotive force as a second-order average force acting on a single charged particle are derived in the form of potential force. The result is valid for arbitrary spatial structure of the ambient static magnetic field. Sum of the resulting drift flux and the second-order magnetic flux due to the induced magnetic moments of the particles is found to agree with the second-order averaged flux calculated by the fluid model. Author

N92-10646# National Inst. for Fusion Science, Nagoya (Japan). **SIMULATION STUDY OF SCALINGS IN SCRAPE-OFF LAYER PLASMA BY TWO-DIMENSIONAL TRANSPORT CODE** SANAE-I. ITOH (Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan).), NORIAKI UEDA (Mitsubishi Atomic Power Industries, Inc., Tokyo, Japan), and KIMITAKA ITOH Mar. 1990 35 p Sponsored in part by Ministry of Education (ISSN 0915-633X) (NIFS-24) Avail: CASI HC A03/MF A01

Numerical analysis on Scrape-Off Layer (SOL) plasma and divertor plasma in tokamaks is made by using 2-D time-dependent transport code (UEDA code). Plasma transport in SOL and the divertor region is calculated for given particle and heat sources from the main plasma. Scaling study of the density, the temperature, and their fall-off lengths is done for JFT-2M tokamak. The results show inter-relations between the divertor plasma parameters and the core plasma confinement. The operational conditions of the core to guarantee the divertor performance are discussed. Author

N92-10647# National Inst. for Fusion Science, Nagoya (Japan). **OBSERVATION OF PLASMA TOROIDAL ROTATIONS DRIVEN BY THE ELECTRIC FIELD DUE TO A LOSS OF IONS** K. IDA, K. KAWAHATA, K. TOI, T. WATARI, O. KANEKO, Y. OGAWA, H. SANUKI, K. ADATI, R. AKIYAMA, A. ANDO et al. Mar. 1990 16 p (ISSN 0915-633X) (NIFS-23) Avail: CASI HC A03/MF A01

Plasma toroidal rotations not driven by the momentum input but by the electric field due to a loss of ions were observed for the plasmas heated with perpendicular neutral beam injection. They are found to be increased in the counter direction to the plasma current as plasma ions are heated with ion cyclotron resonance frequency waves. The electric field derived from rotations are quantitatively consistent with those inferred from the ambipolarity of particle fluxes. Author

N92-10648# National Inst. for Fusion Science, Nagoya (Japan). **THE MEANDERING ORBIT EFFECT ON STABILIZATION OF THE TILTING INSTABILITY IN A FIELD-REVERSED CONFIGURATION** RITOKU HORIUCHI (Science Project Corp., Hiroshima, Japan) and TETSUYA SATO Mar. 1990 35 p Sponsored by Ministry of Education, Science and Culture (ISSN 0915-633X) (NIFS-22) Avail: CASI HC A03/MF A01

Ion kinetic effect in the tilt disruption of a field reversed configuration is studied by means of a 3-D particle simulation. It is found that the tilt disruption is completely suppressed when $s(\text{vector}) \approx 1$, where $s(\text{vector})$ measures the number of ion gyroradii over the radial distance between the magnetic separatrix line and the field-null line. Prolate magnetic well is formed around the field-null line, in which ions do not execute gyration but meander along the field-null line. For the case of $s(\text{vector}) \approx 1$, a large number of ions exist in the magnetic well and move on stable orbits around the major axis with the average rotation velocity nearly equal to half of the thermal velocity. As $s(\text{vector})$ becomes larger than 1, the number of ions in the magnetic well decreases and the stabilization effect is reduced. It is also found that an anisotropy is created in the ion thermal pressure

profile owing to the anisotropy of the meandering orbits and that the electric field fluctuation always remain at a low level, thus the electric field plays no essential role in the tilt stabilization. Author

N92-10649# National Inst. for Fusion Science, Nagoya (Japan). **FAST WAVE HEATING AT INTERMEDIATE ION CYCLOTRON HARMONICS ON THE JIPP T-II U TOKAMAK** Y. TAKASE (Massachusetts Inst. of Tech., Cambridge.), T. WATARI, R. KUMAZAWA, T. SEKI, K. ADATI, R. ANDO, T. AOKI, Y. HAMADA, S. HIROKURA, K. IDA et al. Feb. 1990 25 p Sponsored by Ministry of Education (Contract DE-AC02-78ET-51013) (ISSN 0915-633X) (NIFS-21) Avail: CASI HC A03/MF A01

Fast wave absorption and heating at a relatively high ion cyclotron harmonic were studied on the JIPP T-II U tokamak. In spite of the low absorption efficiency predicted by a simple theory for present experimental parameters, appreciable electron and ion heating was observed. Heating is most effective at relatively low densities. Ion trail was observed on the majority deuterium energy spectrum but not on the minority hydrogen spectrum, which suggests the possibility of direct absorption of mode-converted ion Bernstein wave power by deuterium ions. Because of the density rise caused by radio frequency injection, clear evidence of fast wave driven current was not observed. Author

N92-10654# National Inst. for Fusion Science, Nagoya (Japan). **HIGH RESOLUTION SPECTROSCOPY OF H(+) ENERGY LOSS IN THIN CARBON FILM** NORIAKI MATSUNAMI (Nagoya Univ. (Japan).) and KENSHIN KITOH (Nagoya Univ., Japan) May 1991 21 p (ISSN 0915-633X) (NIFS-88; AD-B157231L) Avail: CASI HC A03/MF A01

The energy loss of approximately 100 keV H(+) transmitted through thin carbon film of approximately 7 nm was measured with the resolution of approximately 20 eV. We observed new energy loss peaks around 210 and 400 eV in addition to the normal energy loss peak around 1 keV. We find that the experimental artifacts, ionization of C K-(290 eV) and impurity inner-shells, extreme non-uniformity of films, events associated with elastic scattering are not responsible for these peaks. The origin of these energy loss peaks is discussed. Author

N92-10655# National Inst. for Fusion Science, Nagoya (Japan). **GEOMETRICAL EFFECTS OF THE MAGNETIC FIELD ON THE NEOCLASSICAL FLOW, CURRENT, AND ROTATION IN GENERAL TOROIDAL SYSTEMS** N. NAKAJIMA and M. OKAMOTO May 1991 34 p Sponsored by Ministry of Education, Science and Culture (ISSN 0915-633X) (NIFS-86; AD-B157236L) Avail: CASI HC A03/MF A01

In order to clarify geometrical effects of the magnetic field on neoclassical theory, the neoclassical parallel particle flow, heat flux, current, and plasma rotation of a multispecies plasma in general toroidal systems are examined in several collisionality regimes. The quantitative and qualitative differences between axisymmetric (tokamak) and non-axisymmetric toroidal systems (stellarators, heliotron/torsatron) appear mainly through a geometrical factor which prescribes the parallel flow due to the gradients of the density, temperature, and electrostatic potential. In axisymmetric toroidal systems the geometrical factor reduces to the same expression in all collisionality regimes due to axisymmetry. By contrast, in non-axisymmetric toroidal systems, it changes drastically depending on the magnetic field structure and the collisionality regime. Thus, the poloidal flow has the radial electric field dependence. When the geometrical factor is very small, the ion parallel flow almost vanishes and the ion rotation consists of the diamagnetic and $E(\text{vector}) \times B(\text{vector})$ flows (perpendicular flows). Author

75 PLASMA PHYSICS

N92-10656# National Inst. for Fusion Science, Nagoya (Japan).
DEPENDENCE OF AU(-) PRODUCTION UPON THE TARGET WORK FUNCTION IN A PLASMA-SPUTTER-TYPE NEGATIVE ION SOURCE

YUSHIROU OKABE (Institute of Physical and Chemical Research, Saitama (Japan).), MAMIKO SASAO (Doshisha Univ., Kyoto (Japan).), HITOSHI YAMAOKA, MOTOI WADA (Doshisha Univ., Kyoto, Japan), and JUNJI FUJITA May 1991 31 p Sponsored in part by Ministry of Education, Science and Culture (ISSN 0915-633X)

(NIFS-85; AD-B157235L) Avail: CASI HC A03/MF A01

A method to measure the work function of the target surface in a plasma-sputter-type negative ion source was developed. The present method can be used to determine the work function by measuring the photoelectric current induced by two lasers (He-Ne, Ar(+) laser). The dependence of Au(-) production upon the work function of the target surface in the ion source was studied using this method. The time variation of the target work function and Au(-) production rate were measured during the cesium coverage decrease due to the plasma ion sputtering. The observed minimum work function of a cesiated gold surface in an AR plasma was 1.3 eV where the negative ion production rate (Au(-) current/target current) took the maximum value. The negative ion production rate showed the same dependence on the incident ion energy as that of the sputtering rate when the work function was constant.

Author

N92-10657# National Inst. for Fusion Science, Nagoya (Japan).
DENSITY PEAKING IN THE JFT-2M TOKAMAK PLASMA WITH COUNTER NEUTRAL BEAM INJECTION

K. IDA (Japan Atomic Energy Research Inst., Ibaraki.), SANAE-I. ITOH (Japan Atomic Energy Research Inst., Ibaraki.), KIMITAKA ITOH (Japan Atomic Energy Research Inst., Ibaraki.), S. HIDEKUMA (Japan Atomic Energy Research Inst., Ibaraki.), Y. MIURA (Japan Atomic Energy Research Inst., Ibaraki.), H. KAWASHIMA, M. MORI, T. MATSUDA, N. SUZUKI, H. TAMAI (Japan Atomic Energy Research Inst., Ibaraki.) et al. May 1991 22 p (ISSN 0915-633X)

(NIFS-83; AD-B157233L) Avail: CASI HC A03/MF A01

A significant particle pinch and reduction of the effective thermal diffusivity are observed after switching the neutral beam direction from co- to counter- injection in the JFT-2M tokamak. A time delay in the occurrence of density peaking to that of plasma rotation is found. This shows that the particle pinch is related to the profile of the electric field as determined by the plasma rotation profile. The measured particle flux shows qualitative agreement with the theoretically-predicted inward pinch.

Author

N92-11796# National Inst. for Fusion Science, Nagoya (Japan).
ON RADIAL ELECTRIC FIELD STRUCTURE IN CHS TORSATRON/HELIOTRON

H. SANUKI, KIMITAKA ITOH, KATSUMI IDA, and SANAE-I. ITOH Jun. 1991 33 p (ISSN 0915-633X)

(NIFS-94; AD-B157848L) Avail: CASI HC A03/MF A01

The radial electric field structure in helical systems is discussed taking into account the effects of the orbit loss and charge exchange loss in addition to the neoclassical fluxes. Analysis is made for the CHS torsatron/heliotron, in which the radial electric field was estimated experimentally. It was found that the fast ion orbit loss and charge exchange loss have strong influence on the profile of the radial electric field, particularly near the plasma periphery. The absolute value of the radial electric field in the experiments is still more negative than the theoretical prediction.

Author

N92-11797# National Inst. for Fusion Science, Nagoya (Japan).
INFLUENCE OF FAST ION LOSS ON RADIAL ELECTRIC FIELD IN WENDELSTEIN 7-A STELLARATOR

KIMITAKA ITOH, H. SANUKI, and SANAE-I. ITOH Jun. 1991 22 p (ISSN 0915-633X)

(NIFS-95; AD-B157849L) Avail: CASI HC A03/MF A01

A theoretical model is developed to determine the radial electric field and the fast ion loss simultaneously in stellarators, and is applied to the Wendelstein 7-A Stellarator. The predicted value of the radial electric field is closer to experiments than the purely neoclassical calculation. The loss rate, which is determined simultaneously, is in the range of experimental observations.

Author

N92-11798# National Inst. for Fusion Science, Nagoya (Japan).
SYMPOSIUM ON DEVELOPMENT AND APPLICATIONS OF INTENSE PULSED PARTICLE BEAMS

KIYOSHI YATSUI, ed. Jun. 1991 143 p Symposium held in Nagoya, Japan, 6-7 Dec. 1990 (ISSN 0915-6348)

(NIFS-PROC-8) Avail: CASI HC A07/MF A02

Papers from the symposium are presented. The following topics are covered: (1) light ion beam interaction with target of indirect driven ICF; (2) ion-beam power amplification through x ray conversion; (3) proton beam fusion; (4) developments for high performance light ion beams; (5) generation and focusing of a proton beam by an inverse pinch ion diode; (6) optimization of a self-magnetically insulated plasma focus diode; (7) diagnostics and evaluation of an anode plasma in a point pinch diode; (8) an experimental study on the spectrum of microwave radiation from intense relativistic electron beam (IREB)-plasma interactions; (9) characteristics of plasma injection type pulsed ion diodes; (10) development of intense negative ion sources; (11) production of pulsed beams of negative light-heavy ions; (12) pulsed power generation by an inductive energy storage system; (13) generation of relativistic electron beams by pulsed power generation using an inductive storage system; and (14) intense beams of highly-ionized metallic ions generated in the point pinch diode.

Author

N92-11799# National Inst. for Fusion Science, Nagoya (Japan).
PROCEEDINGS OF THE FIRST INTERNATIONAL TOKI CONFERENCE ON PLASMA PHYSICS AND CONTROLLED NUCLEAR FUSION: NEXT GENERATION EXPERIMENTS IN HELICAL SYSTEMS

Mar. 1990 292 p Conference held in Toki, Japan, 4-7 Dec. 1989 Submitted for publication (ISSN 0915-6348)

(NIFS-PROC-3) Avail: CASI HC A13/MF A03

The First International Conference on Plasma Physics and Controlled Nuclear Fusion was held on 4-7 December 1989, in Tokishi Bunka Plaza. Topics discussed include the status of the Large Helical Device, the design of the Compact Auburn Torsatron, magnetohydrodynamic stability, drift optimization in helical systems, plasma transport in advanced stellarators, tokamak devices, and the Advanced Toroidal Facility.

N92-11800# National Inst. for Fusion Science, Nagoya (Japan).
LHD Design Group.

PRESENT STATUS OF THE LARGE HELICAL DEVICE PROJECT

OSAMU MOTOJIMA In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 3-6 Mar. 1990

Avail: CASI HC A01/MF A03

The National Institute for Fusion Science is a new large fusion research institute in Japan. It is responsible for the joint university researches of plasma physics and fusion technology. The major experimental facility of the institute is the Large Helical Device (LHD), which is now in the phase of practical design. Described here is the design study of the LHD. The goal is the demonstration of high energy and high bar-beta' plasma production in the helical device, which is a necessary step toward the realization of the helical reactor system.

Author

N92-11808# National Inst. for Fusion Science, Nagoya (Japan).
THE 3-D EQUILIBRIA OF HELICAL SYSTEMS: MAGNETIC ISLANDS AND THEIR CONTROL

TAKAYA HAYASHI *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 37-40 Mar. 1990

Avail: CASI HC A01/MF A03

Three dimensional equilibrium and breaking of magnetic surfaces due to the finite beta effect in a 1 equals 2 heliotron configuration are studied by using a newly developed three-dimensional equilibrium code. Several methods to suppress the breaking are discussed. Author

N92-11810# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

DRIFT OPTIMIZATION OF HELICAL SYSTEMS

KIYOSHI HANATANI *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 45-48 Mar. 1990

Avail: CASI HC A01/MF A03

The minimization of the particle loss region of heliotron/torsatron configurations is considered. Both Heliotron E (high aspect ratio) and Large Helical Device (LHD) (low aspect ratio) configurations are examined and compared. In the drift optimization of Heliotron E, the vertical field $B_{\text{sub } v}$ is used to minimize the loss region. The ultimate shift of magnetic axis $\Delta_{\text{sub } v}$ (opt) and operation window with respect to $B_{\text{sub } v}$ are predicted and compared with Heliotron E experiments. Correlations between the theoretical prediction and experimental observations are discussed. As for the LHD configuration, modulations of the helical field (HF) coil and multipole moments from the poloidal field (PF) coil set are used to minimize the loss region. It is shown that the loss region of a LHD configuration can be reduced as narrowly as that of the standard Heliotron E configuration by simultaneous control of the vertical and quadrupole field. Author

N92-11813# Hokkaido Univ., Sapporo (Japan). Dept. of Nuclear Engineering.

GRAPHITES AS PLASMA FACING MATERIAL OF A LARGE FUSION DEVICE

TOMOAKI HINO and **TOSHIRO YAMASHINA** *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 57-60 Mar. 1990

Avail: CASI HC A01/MF A03

Several graphites, such as the first wall materials of the Large Helical System, are evaluated in terms of erosion, thermal shock resistance, and recycling. Adequate graphites are suggested, and the required conditions such as baking, cooling, and the discharge cleaning are discussed. Author

N92-11815# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

ANALYSIS OF SCRAPE-OFF LAYER IN TOROIDAL HELICAL SYSTEMS

KAZUNOBU NAGASAKI (Okayama Univ. (Japan).), **KIMITAKA ITOH** (Okayama Univ. (Japan).), **SANAE-I. ITOH** (Okayama Univ. (Japan).), and **ATSUSHI FUKUYAMA** (Okayama Univ., Japan) *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 65-68 Mar. 1990

Avail: CASI HC A01/MF A03

Magnetic field structure of the scrape-off layer region in toroidal helical systems is analyzed by using toroidal harmonic functions. The connection length of the field line to the wall is calculated for various configurations. It is found that L has a logarithmic dependence on the distance from the outermost magnetic surface or from the residual magnetic islands. The effect of the axisymmetric fields on the stress structure is also discussed. Author

N92-11817# National Inst. for Fusion Science, Nagoya (Japan).

CONFINEMENT IMPROVEMENT BY EDGE CONTROL

NARUYOSHI OHYABU *In its* Proceedings of the First International

Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 70-72 Mar. 1990

Avail: CASI HC A01/MF A03

Three types of diverter operation were considered to improve the plasma performance, particularly the energy confinement in the Large Helical Diverter (LHD) device. They are (1) high density, cold diverter plasma operation for reducing the purity sputtering; (2) H-mode type operation for minimizing the deterioration of the energy confinement at high input power; and (3) high temperature diverter plasma operation for further enhancement of the energy confinement. The major goal of the helical diverter system is that a wide range of diverter operation modes or scenarios can be attempted to optimize overall plasma performance. Author

N92-11818# National Inst. for Fusion Science, Nagoya (Japan).

EFFECTS OF PERTURBING HELICAL FIELDS ON CONFINEMENT OF HELIOTRON DR PLASMA

SHIGEYUKI MORIMOTO (Nagoya Inst. of Tech. (Japan).), **M. NAKASUGA** (Kyoto Univ. (Japan).), **N. YANAGI** (Nagoya Inst. of Tech. (Japan).), **MOTOYASU SATO** (Kyoto Univ. (Japan).), and **TOKUHIRO OBIKI** (Kyoto Univ., Uji, Japan) *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 73-76 Mar. 1990

Avail: CASI HC A01/MF A03

Two types of perturbing helical fields were applied to Heliotron DR plasma: type A makes a large $m=n=1$ magnetic island at $r/a_{\text{sub } p}$ is similar to 0.5; whereas type B makes a set of many islands with high mode numbers ($m=5, 4, 3, \dots; n=5, 6, 7, 8, 9, 10$) at 0.5 similar to or less than $r/a_{\text{sub } p}$ similar to or less than 1. Deterioration of plasma confinement due to the type A perturbation was observed at $B_{\text{sub } 1}$, $\text{sub } 1/B_{\text{sub } t}$ similar to $3 \times 10^{(exp -4)}$, where $B_{\text{sub } 1}$, $\text{sub } 1$ and $B_{\text{sub } t}$ are the Fourier component of $m=n=1$ and the confining toroidal field, respectively. The plasma performance is less sensitive to the type B perturbation and the confinement deterioration was not found even at zeta greater than 1, where zeta is the overlapping parameters of the magnetic islands. Author

N92-11822# Kyoto Univ. (Japan). Plasma Physics Lab.

REVIEW OF HELIOTRON E EXPERIMENT

TOKUHIRO OBIKI, **HIDEKI ZUSHI**, **FUMIMICHI SANO**, **SHIGERU SUDO**, **KATSUMI KONDO**, **MOTOYASU SATO**, **M. NAKASUGA**, **T. MIZUUCHI**, **SAKAE BESSHO**, **H. OKADA** et al. *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 89-92 Mar. 1990

Avail: CASI HC A01/MF A03

The effects of the magnetic configuration on edge plasma parameters, plasma wall interaction, transport improvement, MHD activities, and fast ion confinement are studied by varying the vertical field and the toroidal field. The role of the vertical field is a change in the magnetic well/hill formation and the helical ripple localization by the axis shift vertical Δ . With toroidal field, the shape and size of the plasma cross section, the rotational transform and, as a consequence, shear are changed. The conclusions are summarized as follows: (1) results of edge diagnostics qualitatively agree with the change in the magnetic limiter configuration by the toroidal field; (2) the transport improvement is found in the inward shift case with a small toroidal field; (3) the stabilization effect of the toroidal field on the $m=2/n=1$ and $m=1/n=1$ modes is found; and (4) observed inward shifted CX flux distribution agrees well with the trapped particle orbit theory. Author

N92-11823# National Inst. for Fusion Science, Nagoya (Japan).

REVIEW OF CHS EXPERIMENT

KEISUKE MATSUOKA (Nagoya Univ. (Japan).), **MASAMI FUJIWARA** (Nagoya Univ. (Japan).), **J. H. HARRIS** (Nagoya Univ. (Japan).), **MINOLU HOSOKAWA** (Nagoya Univ. (Japan).), **KATSUMI IDA** (Nagoya Univ. (Japan).), **H. IDEI** (Nagoya Univ. (Japan).), **HARUKAZU IGUCHI** (Nagoya Univ. (Japan).), **OSAMU KANEKO**

75 PLASMA PHYSICS

(Nagoya Univ. (Japan).), SHIN KUBO (Nagoya Univ. (Japan).), K. MASAI (Nagoya Univ., Japan) et al. *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 93-96 Mar. 1990

Avail: CASI HC A01/MF A03

Heating experiments with 28 GHz/53 GHz Electron Cyclotron Heating (ECH) and Neutral Beam Injection (NBI) were done under the following conditions: the field strength of the toroidal field from 0.46T to 1.5T, heating powers up to 150 kW and 1.1 MW for ECH and NBI respectively. The line averaged electron density $n_{\text{sub e}}$ is 0.1 similar to $10 \times 10^{13}/\text{cm}^3$, electron and ion temperatures are up to about 1.1 keV and 600 eV respectively: the collisionality ranges from the plateau to 1/upsilon regime. Magnetic field configuration study, where the magnetic axis position is scanned from the viewpoint of loss cone, shows that the confinement characteristics improve at an inward shifted axis position. Global energy confinement time is found to follow the Large Helical Device (LHD) scaling and to be improved compared with the scaling in some discharges. Author

N92-11824# Tohoku Univ., Sendai (Japan). Dept. of Nuclear Engineering.

EXPERIMENTAL STUDIES OF A HELICAL AXIS STELLARATOR (TU-HELIAE)

SUMIO KITAJIMA, M. TAKAYAMA, T. ZAMA, M. TAKAHASHI, N. TAKEUCHI, and HIROSHIGE WATANABE *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 97-100 Mar. 1990

Avail: CASI HC A01/MF A03

The recent experimental results are presented on TU-Heliac. TU-Heliac is a helical axis stellarator of heliac type and was built at Sendai in July 1988. The device description is given elsewhere. TU-Heliac has 4 periods, 48 cm of major radius, maximum toroidal field of 3.5 kG, and an average plasma radius of 6 to 8 cm. The swing radius of TF coil is 8 cm. The topics presented deal with measurements of the vacuum magnetic surfaces of TU-Heliac by three different kinds of electron beam methods, and measurements of 2-D contour of the plasma pressure to ensure the existence of the plasma equilibrium in a heliac and brief analytical calculation of the toroidal heliac equilibria. Author

N92-11832# National Inst. for Fusion Science, Nagoya (Japan). **DESTRUCTION OF MAGNETIC SURFACES IN HELICAL TORUS**

JIRO TODOROKI *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 123-126 Mar. 1990 Sponsored by Ministry of Education, Science and Culture

Avail: CASI HC A01/MF A03

The toroidal magnetic field is decomposed into two parts, the field consisting of the magnetic surfaces, and the field part destroying the magnetic surfaces. The structure of the surface destroying part is determined only by the helical coils, and determines the bound of the magnetic surface, as well as the structure of the divertor magnetic field lines. Author

N92-11833# National Inst. for Fusion Science, Nagoya (Japan). **RIPPLE DIFFUSION AND BOOTSTRAP CURRENT IN LHD**

TSUNEO AMANO (Nagoya Inst. of Tech. (Japan).), MASAO OKAMOTO (Nagoya Inst. of Tech. (Japan).), NORIYOSHI NAKAJIMA (Nagoya Inst. of Tech. (Japan).), YUICHI OGAWA (Nagoya Inst. of Tech. (Japan).), KOZO YAMAZAKI (Nagoya Inst. of Tech. (Japan).), S. P. HIRSHMAN (Oak Ridge National Lab., TN.), and W. I. VANRIJ (Oak Ridge National Lab., TN.) *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 127-129 Mar. 1990

Avail: CASI HC A01/MF A03

Ripple diffusion and bootstrap current are calculated for the plasma of Large Helical Device (LHD) with $L = 2$, $M = 10$, $R =$

4 m, and $B = 4\text{T}$. The ripple diffusion is calculated by using GIOTA and DKES codes. GIOTA code calculates the diffusion coefficient in $1/\nu$ regime very quickly and DKES calculates the neoclassical transport coefficients in all collisionality regime by solving drift kinetic equation. Bootstrap current is evaluated by using the formulation given in refs 3 and 4. Author

N92-11834# National Inst. for Fusion Science, Nagoya (Japan). **NUMERICAL ANALYSIS OF TEMPORAL DEVELOPMENT OF RF-HEATED PLASMA**

TSUGUHIRO WATANABE *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 130-133 Mar. 1990

Avail: CASI HC A01/MF A03

Numerical calculation of an overall temporal development of an RF heated straight plasma cylinder is tried by a new numerical method HIDM (Higher order Implicit Difference Method). The plasma is described by electron, ion, and neutral atom fluids (3 fluid model), with ionization, recombination, and charge exchange processes being taken into account. Author

N92-11837# Toshiba Corp., Yokohama (Japan).

STRUCTURAL DESIGN OF LARGE HELICAL DEVICE

K. KITAMURA (Toshiba Corp., Yokohama (Japan).), MASANAO SHIBUI (Toshiba Corp., Yokohama (Japan).), KEIICHI YAMAMOTO (Toshiba Corp., Yokohama (Japan).), S. NAKAMOTO (Toshiba Corp., Yokohama (Japan).), S. MIZUMAKI (Toshiba Corp., Yokohama (Japan).), H. TAKANO (Toshiba Corp., Yokohama (Japan).), Y. WACHI (Toshiba Corp., Yokohama (Japan).), T. HAMAJIMA (Toshiba Corp., Yokohama (Japan).), T. SASAKI (Toshiba Corp., Yokohama (Japan).), OSAMU MOTOJIMA (National Inst. for Fusion Science, Nagoya, Japan) et al. *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 139-142 Mar. 1990

Avail: CASI HC A01/MF A03

A structural design of the Large Helical Device (LHD) was performed with proposals of: (1) application to forced flow superconductor to helical and poloidal coils; (2) toroidal shell for support structure of the coils; and (3) corrugated vacuum vessel with high temperature difference between inner and outer skins. Structural analyses of these components were also carried out to understand their mechanical behaviors including load transmission and to assess the structural reliabilities of the LHD. Author

N92-11838# Toshiba Corp., Yokohama (Japan).

RESEARCH AND DEVELOPMENT OF FORCED FLOW SUPERCONDUCTING COILS FOR LARGE HELICAL DEVICE

SHIGENORI TSURUGA, KEIICHI YAMAMOTO, K. NAKAMOTO, S. MIZUMAKI, H. TAKANO, MASANAO SHIBUI, K. KITAMURA, T. UCHIDA, Y. WACHI, SHIGERU IOKA et al. *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 143-146 Mar. 1990

Avail: CASI HC A01/MF A03

A forced flow superconducting coil was proposed for application to coils of the Large Helical Device (LHD). The main objectives of R&D are to study characteristics of a forced flow superconducting coil and to examine fabricability of a large helical coil for the LHD. A R&D facility consists of a cryostat with 30 kA power leads and two types of R&D coils. Cable-in-conduit type superconductors using NbTi/Cu are adopted for the coils. A computer controlled winding machine was developed in order to fabricate the TOKI TF (helical coil). The design features of the R&D facility are presented. Author

N92-11839# Hitachi Ltd. (Japan).

POOL-COOLED SUPERCONDUCTING MAGNET DESIGN OF LARGE HELICAL DEVICE

S. SUZUKI (Kyushu Univ., Fukuoka (Japan).), H. MIYAZAWA

(Kyushu Univ., Fukuoka (Japan).), R. SAITO (Kyushu Univ., Fukuoka (Japan).), F. IIDA (Kyushu Univ., Fukuoka (Japan).), H. OGATA (Kyushu Univ., Fukuoka (Japan).), Y. YAMAZAKI (Kyushu Univ., Fukuoka (Japan).), OSAMU MOTOJIMA (Kyushu Univ., Fukuoka (Japan).), JUNYA YAMAMOTO (Kyushu Univ., Fukuoka (Japan).), MASAMI FUJIWARA (Kyushu Univ., Fukuoka (Japan).), and M. TAKEO (Kyushu Univ., Fukuoka, Japan) *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 147-150 Mar. 1990

Avail: CASI HC A01/MF A03

The Large Helical Device is the next generation in helical equipment for nuclear fusion. The large scale superconducting magnets are going to be applied to these coils. The major and minor radius of the helical coil system are 4 and 0.96 m respectively and the magnetic field is 4 T at the plasma center and 8 T at the coil surface. The coil system stores about 2 GJ of total energy. The superconductor of the helical coil is pure aluminum stabilized Nb-Ti compacted strand cable with copper housing. The coils have a stainless-steel helium can that is filled with liquid helium. This pool-cooled superconducting helical coil system satisfies the fully stabilized condition. The superconducting poloidal coils are composed of six (three pairs) circular coils and use forced-cooled superconductors to reduce the eddy current losses by the field changing operation. The helical and poloidal coil system are built in the large bell-jar (vacuum vessel for thermal insulation) with outer diameter of 13 m. Conductor design and stability of superconducting magnets for helical and poloidal coil systems are described.

Author

**N92-11840# Hitachi Ltd. (Japan). Energy Research Lab.
BEHAVIOR OF VACUUM VESSEL EDDY CURRENT IN LARGE
HELICAL DEVICE**

HIDESHI FUKUMOTO (Nagoya Inst. of Tech. (Japan).), SHIGEYOSHI KINOSHITA (Nagoya Inst. of Tech. (Japan).), MICHIO OTSUKA (Nagoya Inst. of Tech. (Japan).), NOBUYOSHI OHYABU, NOBUAKI NODA, KOZO YAMAZAKI, and OSAMU MOTOJIMA (National Inst. for Fusion Science, Nagoya, Japan) *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 151-154 Mar. 1990

Avail: CASI HC A01/MF A03

The eddy current on a Large Helical Device was analyzed to understand its flow pattern on the vacuum vessel with helical structure in the existence of helical field or poloidal field change. The magnetic field in the plasma region and the electromagnetic force induced by the eddy current were also evaluated.

Author

**N92-11841# Mitsubishi Fusion Center, Tokyo (Japan).
FUNDAMENTAL DESIGN ON LHD WITH BATH COOLING
METHOD**

SHIGERU TADO (Mitsubishi Fusion Center, Tokyo (Japan).), KATSUHIRO SHIMIZU (Mitsubishi Fusion Center, Tokyo (Japan).), B. IKEDA (Mitsubishi Fusion Center, Tokyo (Japan).), A. KAMEARI (Mitsubishi Fusion Center, Tokyo (Japan).), R. SAITO (Mitsubishi Fusion Center, Tokyo (Japan).), M. TOMITA (Mitsubishi Fusion Center, Tokyo (Japan).), TADANORI TSUKAMOTO (Mitsubishi Fusion Center, Tokyo (Japan).), K. KUNO (Mitsubishi Electric Corp., Kobe (Japan).), K. TOYOTA (Mitsubishi Electric Corp., Kobe (Japan).), T. SATOW (Mitsubishi Electric Co., Kobe, Japan) et al. *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 155-158 Mar. 1990

Avail: CASI HC A01/MF A03

The Large Helical Device (LHD) is a fusion experimental device of heliotron type. The results of the structural analyses which were made on the superconducting magnetic coil support structure and the vacuum vessel are described as a preliminary design study of the LHD.

Author

N92-11842# Mitsubishi Electric Corp., Kobe (Japan).

**A COMPACT HELICAL DEVICE FOR A SUPERCONDUCTING
LARGE HELICAL COIL**

YOSHIYUKI TSUDA (Mitsubishi Electric Corp., Kobe (Japan).), K. TOYODA (Mitsubishi Electric Corp., Kobe (Japan).), T. HIRAYAMA (Mitsubishi Electric Corp., Kobe (Japan).), S. KIDA (Mitsubishi Electric Corp., Kobe (Japan).), K. KUNO (Mitsubishi Electric Corp., Kobe (Japan).), T. MITO (Kyoto Univ. (Japan).), JUNYA YAMAMOTO (Nagoya Inst. of Tech. (Japan).), K. TAKAHATA (Nagoya Inst. of Tech. (Japan).), M. TAKEO (Kyushu Univ., Fukuoka (Japan).), I. OHTAKE (National Inst. for Fusion Science, Nagoya, Japan) et al. *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 159-162 Mar. 1990

Avail: CASI HC A01/MF A03

A superconducting helical coil was constructed. The fabricated coil has a major radius of 300 mm and a minor radius of 62.7mm. In order to simulate the construction technique of a large helical coil, the small-scale coil was wound with the computer controlled winding machine that was developed for the automatic helical winding. Useful technical data was gained about the fabrication of a superconducting helical coil, and the feasibility of fabricating a large helical coil was confirmed.

Author

**N92-11843# National Inst. for Fusion Science, Nagoya (Japan).
OPTIMIZATION OF DESIGN PARAMETERS FOR LARGE
HELICAL DEVICE**

KOZO YAMAZAKI (Nagoya Inst. of Tech. (Japan).), MAKOTO ASAO (Kobe Steel Ltd., Japan), and OSAMU MOTOJIMA *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 163-166 Mar. 1990

Avail: CASI HC A01/MF A03

The convenient scaling formula for plasma configurations and engineering design parameters of $l = 2$ helical systems are derived from a wide range of computations. Using these formula, optimized designs of heliotron/torsatron experimental devices with NbTi superconducting coils are surveyed for the next generation of machines. An $l = 2 / m = 10 / \gamma$ approximately = 1.2 system with a coil current density of approximately 40 A/sq mm is found as an optimized higher-beta better-confinement configuration with respect to the clean divertor installation, the coil engineering requirements, and the cost optimization.

Author

**N92-11844# National Inst. for Fusion Science, Nagoya (Japan).
EFFECT OF MULTI-LAYER OPERATION OF HELICAL COIL IN
LARGE HELICAL DEVICE**

MAKOTO ASAO (Kobe Steel Ltd., Japan), KOZO YAMAZAKI, and OSAMU MOTOJIMA *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 167-170 Mar. 1990

Avail: CASI HC A01/MF A03

One of the main objectives of the Large Helical Device Project is to investigate the fundamental properties of a helical torus system in wide plasma parameter range. Therefore, it is necessary to design the flexible coil system to obtain various magnetic field configurations. For this purpose, a helical coil is divided into multi-layers to change the helical pitch parameter. A variety of configurations with different rotational transform and minor radius are obtained by this multi-layer operation of the helical coil.

Author

**N92-11845# National Inst. for Fusion Science, Nagoya (Japan).
ECH SYSTEM IN THE LARGE HELICAL DEVICE**

KUNIZO OHKUBO (Nagoya Inst. of Tech. (Japan).), MINOLU HOSOKAWA (Nagoya Inst. of Tech. (Japan).), SHIN KUBO (Nagoya Inst. of Tech. (Japan).), TAKASHI MUTOH (Nagoya Inst. of Tech. (Japan).), MOTOYASU SATO (Kyoto Univ., Japan), RYUHEI KUMAZAWA (Nagoya Inst. of Tech. (Japan).), TETSUO WATARI (Nagoya Inst. of Tech. (Japan).), and TSUTOMU KURODA *In its* Proceedings of the First International Toki Conference on Plasma

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Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 171-174 Mar. 1990

Avail: CASI HC A01/MF A03

The electron cyclotron heating system will provide 10 MW of RF power for the large helical device. The RF power will be generated by ten 1 MW gyrotrons and transmitted via the mirror system and/or the corrugated waveguide. High voltage dc power to the electron cyclotron heating equipment will be supplied from approximately 80 kV power supplies with CW and 10 sec pulsewidth. A control system will interface to the supervisory control system for the large helical device. Author

N92-11846# National Inst. for Fusion Science, Nagoya (Japan).

ICRF HEATING PROGRAM OF THE LARGE HELICAL DEVICE

TAKASHI MUTOH (Okayama Univ. (Japan).), ATSUSHI FUKUYAMA (Okayama Univ. (Japan).), TETSUO WATARI (Kyoto Univ. (Japan).), RYUHEI KUMAZAWA (Kyoto Univ. (Japan).), HIROYUKI OKADA (Kyoto Univ. (Japan).), MASASHI OHNISHI (Kyoto Univ., Uji, Japan), MASAO OKAMOTO (Nagoya Inst. of Tech. (Japan).), KIYOHICO NISHIMURA (Nagoya Inst. of Tech. (Japan).), and TSUTOMU KURODA *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 175-178 Mar. 1990

Avail: CASI HC A01/MF A03

Ion Cyclotron Radio Frequency (ICRF) Heating Programs of the Large Helical Device (LHD) are discussed. The ICRF heating is considered as one of the additional heating methods to achieve the objective plasma parameters and as the useful tool to study the various physics subjects. Theoretical analysis methods were developed, and parameter surveys were carried out to determine optimum heating conditions. Wave propagation and Fokker-Planck analyses are used to evaluate the heating deposition profiles and direct orbit loss effect. Monte-Carlo calculation is also used to confirm the above results. An alpha particle simulation program using ICRF is studied, and it can be examined to a certain extent by forming a similar distribution function in ion velocity space. From these analyses, it becomes clear that the ICRF heating has high potentiality as a useful heating tool, even if the loss cone exists at the radial range of r/a sub p greater than or = 0.4.

Author

N92-11848# Nihon Univ., Tokyo (Japan). Atomic Energy Research Inst.

EQUILIBRIUM, STABILITY, AND TRANSPORT IN $L = 1$

COMPACT HELICAL AXIS CONFIGURATION

HITOSHI KIKUCHI, HIKARU UENO, MASAMITSU AIZAWA, KIYOMITSU SUZUKI, HIROKAZU GESSO, KATSUNORI SAITO, ICHIRO KAWAKAMI, and SHOICHI SHIINA *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 183-187 Mar. 1990

Avail: CASI HC A01/MF A03

The $L = 1$ torsatron is modified by two methods to improve the plasma torsity. The first one is the negative pitch modulation of coil winding. The second is the superposition of a relatively weak $L = -1$ torsatron field. These modifications give rise to a local magnetic well keeping a positive magnetic shear. The equilibrium, stability, and transport of plasma in these modified $L = 1$ torsatrons are described and discussed. Author

N92-11850# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

CONFINEMENT STUDIES OF HELIOTRON E PLASMAS IN MAGNETIC SURFACE VARIATION EXPERIMENTS

FUMIMICHI SANO *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 192-195 Mar. 1990

Avail: CASI HC A01/MF A03

Confinement studies of Heliotron-E neutral beam heated plasmas were carried out with reference to magnetic surface variation by using additional toroidal field, B sub t , as well as

additional vertical field, B sub v . The variation of α^* ($= B$ sub t / B sub h ; B sub h helical field on axis) causes mainly a change in mean plasma radius a sub p and in rotational transform $t(r)$, while that of β^* ($= B$ sub v / B sub h) causes a shift of magnetic axis (δ sub v) and a variation of shear parameter (θ). In the standard configuration (α^* , β^*) = (0, -0.185), the gross energy confinement time, τ sub G sub E , is given empirically as τ sub G sub E (ms) = $13 \times n$ sub -0.53 sub e (10 exp 14/cc) $\times P$ sub -0.71 sub $heat$ (MW) $\times B$ sub 0.35 (T) for neutral beam injection (NBI) plasmas and then the anomalous electron thermal diffusivity χ sub an sub e associated with the above power-degrading scaling is now the crucial problem to be settled. Therefore, from the viewpoint of confinement improvement in the helical system, the investigation of confinement properties as functions of magnetic surface quantities such as a sub p , δ sub v , or θ is of special importance in order to find out the physical mechanism of anomalous diffusivity. The experimental studies of the effects of a sub p on transport with special regard to NBI plasma are described. Author

N92-11851# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

PROFILE MEASUREMENTS IN MAGNETIC SURFACE VARIATION EXPERIMENTS/MULTIPLE PELLET INJECTION EXPERIMENTS

SHIGERU SUDO, T. BABA, MOTOYASU SATO, KATSUMI KONDO, HIDEKI ZUSHI, T. MIZUUCHI, H. OKADA, SAKAE BESSHOU, MASAHIRO WAKATANI, and TOKUHIRO OBIKI *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 196-199 Mar. 1990

Avail: CASI HC A01/MF A03

Temperature and density profile measurements by the Thomson scattering method in magnetic surface variation experiments are presented. The density profile becomes peaked when α^* (identical with B sub $T0$ / B sub $H0$) decreases, while the central electron temperature changes little. This property is common in neutral beam injection (NBI) plasmas. Apart from the α^* value, there is optimization when β^* (identical with B sub $V0$ / B sub $H0$) = -0.192 (δ sub v = -2 cm). When β^* = -0.192, there is optimization when α^* = 0.05 to approximately 0.10. In this case, the edge plasma is observed to expand when α^* is increased from 0 to approximately 0.10. Density clamping of electron cyclotron heating (ECH) plasmas (P sub ECH of approximately 450 kW) is stopped under the condition of α^* greater than 0. The optimum condition is when α^* is approximately 0.05 with β^* = -0.192. A quasi-steady state plasma with a density of n bar sub e = 4×10 (exp 19)/cubic meters, which is higher than the cut-off density of n sub e approximately = 3.5×10 (exp 19) cubic meters, can be produced under the condition of T sub e (0) approximately = 350 eV in the case of α^* = 0.05 and β^* = -0.192. Multiple pellet injection experiments on Heliotron E are described. By multiple pellet injection, the regime of n - T diagram is expanded in the high density region. As a result of high nT plasma production, magnetohydrodynamic (MHD) instability has appeared first in case of $B = 1.9$ T under the standard configuration. A peaked density profile with high density is achieved by pellet injection, which cannot be obtained merely by gas puffing. The behavior of pellet-injected plasma is also studied under the magnetic surface variation. Author

N92-11852# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

IMPURITY BEHAVIOR IN HELIOTRON E

KATSUMI KONDO (Hiroshima Univ. (Japan).), T. ODA (Hiroshima Univ. (Japan).), and K. MIYAKE (Kyoto Univ., Japan) *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 200-203 Mar. 1990

Avail: CASI HC A01/MF A03

Impurity behavior in the Heliotron E plasma was studied by a

vacuum ultraviolet spectrometer in various magnetic configurations with or without a carbon coating on the vacuum chamber wall.

Author

N92-11853# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

EDGE PLASMA STUDY IN HELIOTRON E

T. MIZUUCHI (Osaka Univ. (Japan).), HIROTO MATSUURA (Osaka Univ. (Japan).), A. KOMORI (Kyushu Univ., Fukuoka (Japan).), MITSURU HARADA (Kyushu Univ., Fukuoka (Japan).), S. NAGAI (Kyushu Univ., Fukuoka, Japan), HIDEKI ZUSHI (Kyushu Univ., Fukuoka (Japan).), FUMIMICHI SANO (Kyushu Univ., Fukuoka (Japan).), KATSUMI KONDO (Kyushu Univ., Fukuoka (Japan).), SHIGERU SUDO (Kyushu Univ., Fukuoka (Japan).), SOTOYASU SATO et al. *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 204-207 Mar. 1990

Avail: CASI HC A01/MF A03

The magnetic field configuration of Heliotron E can be controlled by additional toroidal field and/or vertical field. The change of the configuration, especially in the edge region, is experimentally confirmed by measurement of the edge plasma profile and by measurement of the vacuum magnetic surface with the beam impedance method.

Author

N92-11854# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

RECENT DIAMAGNETIC MEASUREMENTS OF TOROIDAL COIL EXPERIMENTS ON HELIOTRON E

SAKAE BESSHO *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 208-211 Mar. 1990

Avail: CASI HC A01/MF A03

Recent results (Jul.-Nov. 1989) on diamagnetic measurements of Heliotron E toroidal coil experiments are described. The status of the system is described, including calibration and electronic signal compensation. Recent results are presented showing the behavior of the stored plasma energy or average beta with additional toroidal field, vertical field, and heating powers. Author

N92-11855# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

STUDY OF RESISTIVE INTERCHANGE MODE IN HELIOTRON E

HIDEKI ZUSHI *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 212-215 Mar. 1990

Avail: CASI HC A01/MF A03

The effects of magnetic axis shift and the toroidal field on pressure driven instabilities are studied. It is found that the internal disruption caused by the interchange modes is sensitive to the magnetic well formation near the magnetic axis. It is also observed that the additional toroidal field ($B(\text{sub } t)/B(\text{sub } h)$ approximately 5 percent) is effective to stabilize it. Dominant instability modes are changed from $m=2/n=1$ or $m=3/n=2$ modes (0 less than r/a less than 0.3) to the $m=1/n=1$ mode (0.6 less than r/a less than 0.7) as beta increases.

Author

N92-11856# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

MEASUREMENT OF MAGNETIC FLUCTUATIONS IN HELIOTRON E

MITSURU HARADA (Kyoto Univ. (Japan).), HIDEKI ZUSHI (Kyoto Univ. (Japan).), FUMIMICHI SANO (Kyoto Univ. (Japan).), T. MIZUUCHI (Kyoto Univ. (Japan).), M. NAKASUGA (Kyoto Univ. (Japan).), SHIGERU SUDO (Kyoto Univ. (Japan).), KATSUMI KONDO (Kyoto Univ. (Japan).), SAKAE BESSHO (Kyoto Univ. (Japan).), MOTOYASU SATO (Kyoto Univ. (Japan).), HIROSHI KANEKO (National Inst. for Fusion Science, Nagoya, Japan) et al. *In* National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 216-219 Mar. 1990

Avail: CASI HC A01/MF A03

In Heliotron E, it was found that pressure driven internal disruptions occur in high beta plasmas. Magnetic fluctuations are thought to have relation to pressure driven instabilities. The cross-correlation analysis of magnetic fluctuations in Heliotron E is presented, and the properties of coherent magnetic oscillations related with magnetohydrodynamic activities affected by the magnetic configurations are discussed.

Author

N92-11857# National Inst. for Fusion Science, Nagoya (Japan).

TRANSPORT STUDY OF ECH AND NBI PLASMAS IN CHS

HIROSHI YAMADA (Nagoya Inst. of Tech. (Japan).), HARUKAZU IGUCHI (Nagoya Inst. of Tech. (Japan).), H. C. HOWE (Oak Ridge Associated Universities, Inc., TN.), YASUHIKO TAKEIRI (Nagoya Inst. of Tech. (Japan).), SHIN KUBO (Nagoya Inst. of Tech. (Japan).), SHOICHI OKAMURA (Nagoya Inst. of Tech. (Japan).), R. N. MORRIS (Oak Ridge Associated Universities, Inc., TN.), and D. K. LEE (Oak Ridge National Lab., TN.) *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 220-223 Mar. 1990

(Contract DE-AC05-84OR-21400)

Avail: CASI HC A01/MF A03

Power balance of ECR (Electron-Cyclotron Resonance) and NBI (Neutral Beam Injector) heated plasmas in CHS (Compact Helical System) was analyzed using the time-dependent transport code PROCTR-mod. The power losses in the ECH (Electron Cyclotron Heated) plasma are dominated by electron heat conduction which is typically larger than the prediction from the neoclassical theory by a factor of 4, while that for the NBI plasmas is several-tens times larger than the prediction from the neoclassical theory.

Author

N92-11858# National Inst. for Fusion Science, Nagoya (Japan).

EFFECT OF MAGNETIC AXIS SHIFT ON CHS PLASMA CHARACTERISTICS

SHOICHI OKAMURA and HARUKAZU IGUCHI *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 224-227 Mar. 1990

Avail: CASI HC A01/MF A03

For the study of plasma transport in helical systems, the comparison of the confinement for different magnetic configurations can give us a lot of useful information for understanding the transport mechanism as well as scaling studies for various plasma parameters. The poloidal coil system of CHS (Compact Helical Systems) device consists of four pairs of hoop coils. Three of them are energized by independent power supplies which make it possible to realize a wide variation of poloidal field configuration. It is possible to decompose the poloidal field structure into a sum of multipole components. We chose the values of dipole (vertical) and quadrupole components as two free parameters to determine the poloidal coil current settings. To determine the third free parameter, we set the condition of minimizing the stray field around the machine with which we can reduce the perturbing field that is brought by the magnetic material around the machine. Author

N92-11859# National Inst. for Fusion Science, Nagoya (Japan).

A STUDY OF RADIATION COLLAPSE IN CHS PLASMAS

SHIGERU MORITA *In its* Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems p 228-231 Mar. 1990

Avail: CASI HC A01/MF A03

It is found that ECH (Electron Cyclotron Heated) plasmas without Ti gettering cause radiation collapse at some magnetic configurations in which plasma-wall distance is extremely decreasing. In NBI plasmas the radiation collapse can be observed even in the Ti-flashed discharges, when strong gas puffing is carried out. Spectroscopic results and analysis indicate that the radiation collapse is caused by the oxygen buildup reaching 10-20 percent and 3-5 percent of electron density in ECH and NBI plasmas, respectively. These critical values decrease because of a flat or hollow electron density profile of the CHS plasmas. In addition,

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hydrocarbon pellets are injected into the NBI plasmas to make these phenomena clear. The spherical pellet injection of 0.46 mm dia. corresponding to 5 percent carbon fraction of electron density causes the radiation collapse. However, the pellet injection of 0.32 mm dia. corresponding to 2.3 percent of electron density does not cause the collapse. The results show good agreement with the analysis. Author

N92-11860# National Inst. for Fusion Science, Nagoya (Japan).
ION TEMPERATURE AND POLOIDAL ROTATION PROFILES FOR NBI HEATED PLASMA IN CHS

KATSUMI IDA and S. HIDEKUMA *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 232-235 Mar. 1990

Avail: CASI HC A01/MF A03

Ion temperature and poloidal rotation velocity profiles are measured with 68 channel space resolved spectrometer using beam emission spectroscopy techniques in CHS. The electric field near the plasma edge derived from poloidal rotation velocity is 15 V/cm for low density 28 GHz ECH plasma, and -35 V/cm for high density NBI plasma. The peak of the ion temperature is shifted from the vacuum magnetic axis and becomes larger as the magnetic axis moves toward the tangential major radius of the heating neutral beam. This shift is larger than that estimated from finite beta calculation by a factor of two or less. Presumably, the shift is due to a significant parallel beam pressure as well as thermal component. Author

N92-11861# National Inst. for Fusion Science, Nagoya (Japan).

DRIVEN CURRENTS IN NEUTRAL BEAM HEATED PLASMA
OSAMU KANEKO, YASUHIKO TAKEIRI, HIROSHI YAMADA, HARUKAZU IGUCHI, SHOICHI OKAMURA, and KEISUKE MATSUOKA *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 236-239 Mar. 1990

Avail: CASI HC A01/MF A03

Plasma currents, which are observed in the tangential neutral beam heated plasma, are studied under the various plasma conditions in CHS. The plasma current is mainly driven by high energy beam when the plasma density is low, while the bootstrap current seems to be dominant in the dense plasma. Author

N92-11862# National Inst. for Fusion Science, Nagoya (Japan).

POWER DEPOSITION DURING ECH IN CHS
SHIN KUBO, MINOLU HOSOKAWA, Y. TAKITA, and H. IDEI *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 240-243 Mar. 1990

Avail: CASI HC A01/MF A03

Power deposition profile and the total absorbed power during electron cyclotron heating (ECH) in CHS are estimated from the resonance structure at each flux surface. The dependence of the central electron temperature on the magnetic field can be well accounted for by this method. Total deposited power into the plasma is estimated from the measurement of the leaking power around the torus. Using this power deposition profile, preliminary confinement analysis of the electron is done. Author

N92-11864# National Inst. for Fusion Science, Nagoya (Japan).

ENGINEERING DESIGN OF LARGE HELICAL DEVICE
JUNYA YAMAMOTO and OSAMU MOTOJIMA *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 248-251 Mar. 1990

Avail: CASI HC A01/MF A03

Engineering design of Large Helical Device and technical subject to realize the device are described. Research and development works of superconducting coils are also introduced. Author

N92-11865# National Inst. for Fusion Science, Nagoya (Japan).

OPERATION SCENARIO AND STRUCTURAL DESIGN ANALYSIS OF LHD (LARGE HELICAL DEVICE) COILS
KOZO YAMAZAKI and OSAMU MOTOJIMA *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 252-255 Mar. 1990

Avail: CASI HC A01/MF A03

Flexible operation modes of coil system are presented for the Large Helical Device (LHD) with $m(\text{field period})=10$, 4-layer HFC (Helical Field Coil) and 3-pair PFC (Poloidal Field Coil) superconducting systems. For these operation modes, electromagnetic force and stress analyses are carried out, and it is clarified that coil supporting system within the permissible stress level is possible with adequate stiffness to keep clean magnetic surface without large magnetic islands. Author

N92-11866# National Inst. for Fusion Science, Nagoya (Japan).

ENGINEERING DESIGN OF LHD VACUUM VESSEL
NARUYOSHI OHYABU and NOBUAKI NODA *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 256-259 Mar. 1990

Avail: CASI HC A01/MF A03

There are two key issues in designing the LHD vacuum vessel: (1) how to accommodate a closed helical divertor system, and (2) how to assemble the vessel. The assembly procedure is quite different, depending on whether it is done before or after the coil winding. The conceptual design of the LHD vacuum vessel is discussed. Author

N92-11867# National Inst. for Fusion Science, Nagoya (Japan).

DEVELOPMENT OF SUPERCONDUCTOR FOR LARGE HELICAL DEVICE
TOSHIYUKI MITO (Nagoya Inst. of Tech. (Japan).), JUNYA YAMAMOTO (Nagoya Inst. of Tech. (Japan).), K. TAKAHATA (Nagoya Inst. of Tech. (Japan).), OSAMU MOTOJIMA (Nagoya Inst. of Tech. (Japan).), and F. SUMIYOSHI (Kagoshima Univ., Japan) *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 260-263 Mar. 1990

Avail: CASI HC A01/MF A03

The present situation of the design and construction of R&D superconducting conductors for Large Helical Device is reported. The required properties for the conductor of LHD and the design criteria of the conductors are mentioned. The designed patterns of the cross sections of R&D conductors are shown. The test and estimation items of conductors are listed. The R&D schedules are shown. Author

N92-11869# Kyoto Univ., Uji (Japan). Plasma Physics Lab.

THE 100 GHZ HALF MEGAWATT MICROWAVE TRANSMISSION SYSTEM DEVELOPMENT WITH WHISPERING GALLERY MODE

MOTOYASU SATO (Kyoto Industrial Univ. (Japan).), M. IIMA (Kyoto Industrial Univ. (Japan).), S. KOBAYASHI (Kyoto Industrial Univ. (Japan).), SHIGERU SUDO (Kyoto Industrial Univ. (Japan).), FUMIMICHI SANO (Kyoto Industrial Univ. (Japan).), HIDEKI ZUSHI (Kyoto Industrial Univ. (Japan).), TOKUHIRO OBIKI (Kyoto Industrial Univ. (Japan).), M. NAKAJIMA (Kyoto Industrial Univ. (Japan).), SHIN KUBO (Nagoya Inst. of Tech. (Japan).), MINOLU HOSOKAWA (National Inst. for Fusion Science, Nagoya, Japan) et al. *In National Inst. for Fusion Science, Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 268-271 Mar. 1990

Avail: CASI HC A01/MF A03

The 106 GHz half megawatt ECRH (Electron Cyclotron Resonance Heating) is under the final stage of development and will serve for the future one megawatt design. The following subject areas are covered: gyatron tube, quasi-optical mode converter development, and transmission line. Author

N92-11870# National Inst. for Fusion Science, Nagoya (Japan).
**NBI SYSTEM WITH NEGATIVE ION SOURCE IN LARGE
 HELICAL DEVICE**

YASUHIKO TAKEIRI (Nagoya Inst. of Tech. (Japan).), OSAMU KANEKO (Nagoya Inst. of Tech. (Japan).), FUMIMICHI SANO (Kyoto Industrial Univ. (Japan).), A. ANDO (Nagoya Inst. of Tech. (Japan).), YOSHIHIDE OKA (Nagoya Inst. of Tech. (Japan).), TOKUHIRO OBIKI (Kyoto Industrial Univ. (Japan).), TSUTOMU KURODA (Nagoya Inst. of Tech. (Japan).), and KIYOSHI HANATANI (Kyoto Univ., Uji, Japan) *In its Proceedings of the First International Toki Conference on Plasma Physics and Controlled Nuclear Fusion: Next Generation Experiments in Helical Systems* p 272-275 Mar. 1990
 Avail: CASI HC A01/MF A03

Negative-ion-based NBI (Neutral Beam Injector) system is designed for Large Helical Device. Injection energy is 125 keV for hydrogen beam and total injection power is 20 MW which is provided by four tangential injectors with two ion sources. Design concept for the system performance and hardware system design are described. Author

N92-11877# National Inst. for Fusion Science, Nagoya (Japan).
EXPERIMENTS AND APPLICATIONS OF SOLITON PHYSICS

YOSHI H. ICHIKAWA Jun. 1990 30 p Presented at the Fourth Tropical Coll. on Applied Physics, Kuala Lumpur, Malaysia, 28 May - 16 Jun. 1990
 (ISSN 0915-633X)
 (NIFS-32) Avail: CASI HC A03/MF A01

Solitons are everywhere in the nature. Various soliton phenomena are surveyed, after giving the mathematical foundation to define solitons. Laboratory devices for the studies of plasma soliton phenomena are described together with experimental results. The most interesting application of soliton physics is illustrated in the discussion of soliton propagation in optical fibers. Topics on chaotic behavior in nonlinear dynamical systems are also briefly discussed. Author

N92-11878# National Inst. for Fusion Science, Nagoya (Japan).
**EFFECTS OF ELECTRIC FIELD ON PARTICLE DRIFT ORBITS
 IN A $L = 2$ TORSATRON**

H. SANUKI (Nagoya Inst. of Tech. (Japan).), T. KAMIMURA (Nagoya Inst. of Tech. (Japan).), KIYOSHI HANATANI (Kyoto Univ., Uji, Japan), KIMITAKA ITOH (Nagoya Inst. of Tech. (Japan).), and JIRO TODOROKI May 1990 39 p
 (ISSN 0915-633X)
 (NIFS-31) Avail: CASI HC A03/MF A01

Particle orbits and loss regions in both real and velocity spaces are studied on the basis of the guiding center drift equations in magnetic coordinates. The boundary of loss region in pitch angle-radius (χ - ρ) plane is determined from the condition whether the drift surfaces for helically trapped and transition particles reach the outermost magnetic surface or not. The loss boundaries for the absolute particle confinement within of which boundary no particles are lost, is evaluated. Effects of the radial electric field, $E_{(sub\ r)}$ on drift orbits and loss regions are discussed in detail. When ion motion is considered, the poloidal rotation modified by a positive $E_{(sub\ r)}$ reduces a number of trapped particles and consequently it leads the improvement of particle confinement. For a small negative $E_{(sub\ r)}$, there is a possible particle loss caused by the helical resonance. The loss rate of ions caused by loss cone in collisionless limit is evaluated in the presence of $E_{(sub\ r)}$. Effect of ripple modulation on the loss region is also discussed briefly. Author

N92-11879# National Inst. for Fusion Science, Nagoya (Japan).
**FOKKER-PLANCK EQUATION IN THE PRESENCE OF
 ANOMALOUS DIFFUSION**

SANAE-I. ITOH (Nagoya Inst. of Tech. (Japan).), A. FUKUYAMA (Okayama Univ., Japan), and KIMITAKA ITOH May 1990 27 p Sponsored in part by Ministry of Education
 (ISSN 0915-633X)
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Spatial and temporal evolution of the distribution function is

theoretically discussed in the presence of the RF waves and microscopic fluctuations. Using the quasilinear formulation, Fokker-Planck equation is derived in terms of the parallel and perpendicular energies and the distance across the magnetic surface. The energy dependence of the anomalous spatial diffusion term is studied for the case of the drift wave fluctuations. Cases for the intense ICRF (Ion Cyclotron Range of Frequencies) heating is also discussed. Author

N92-11880# National Inst. for Fusion Science, Nagoya (Japan).
CALCULATION OF MAGNETIC FIELD OF HELICAL COILS
 JIRO TODOROKI Feb. 1990 11 p Submitted for publication
 Sponsored by Ministry of Education, Science and Culture
 (ISSN 0915-633X)

(NIFS-18) Avail: CASI HC A03/MF A01

Formulae of magnetic field calculations of finite helical coils with rectangular cross sections are extended to the case where the size of the coil, or the relative position to the guiding curve, varies along the arc length of the guiding curve. The error caused by the inappropriate formulae or inappropriate current model is discussed. Author

N92-11882# National Inst. for Fusion Science, Nagoya (Japan).
**ELMY-H MODE AS LIMIT CYCLE AND CHAOTIC
 OSCILLATIONS IN TOKAMAK PLASMAS**

SANAE-I. ITOH (Nagoya Inst. of Tech. (Japan).), KIMITAKA ITOH (Nagoya Inst. of Tech. (Japan).), ATSUSHI FUKUYAMA (Okayama Univ. (Japan).), and YUKITOSHI MIURA (Japan Atomic Energy Research Inst., Tokai.) May 1991 20 p
 (ISSN 0915-633X)

(NIFS-87; AD-B157232L) Avail: CASI HC A03/MF A01

A model of edge localized modes (ELMs) in tokamak plasmas is presented. A limit cycle solution is found in the transport equation (time-dependent Ginzburg-Landau type), which has an hysteresis curve between the gradient and flux. Periodic oscillation of the particle outflux and L/H intermediate state are predicted near the L/H transition boundary. A mesophase in spatial structure appears near the edge. Chaotic oscillation is also predicted. Author

N92-11883# National Inst. for Fusion Science, Nagoya (Japan).
**NONLINEAR BEHAVIOR OF MULTIPLE-HELICITY RESISTIVE
 INTERCHANGE MODES NEAR marginally STABLE
 STATES**

HIDEO SUGAMA (Nagoya Inst. of Tech. (Japan).), NORIYOSHI NAKAJIMA (Nagoya Inst. of Tech. (Japan).), and MASAHIRO WAKATANI (Kyoto Univ., Uji, Japan) May 1991 35 p
 (ISSN 0915-633X)

(NIFS-89; AD-B157230L) Avail: CASI HC A03/MF A01

Nonlinear behavior of resistive interchange modes near marginally stable states is studied under the multiple-helicity condition. Reduced fluid equations in the sheared slab configuration are used in order to treat a local transport problem. With the use of the invariance property of local reduced fluid model equations under a transformation between the modes with different rational surfaces, weakly nonlinear theories for single-helical modes by Hamaguchi and Nakajima are extended to the multiple-helicity case and applied to the resistive interchange modes. We derive the nonlinear amplitude equations of the multiple-helicity modes, from which the convective transport in the saturated state is obtained. It is shown how the convective transport is enhanced by nonlinear interaction between modes with different rational surfaces compared with the single-helicity case. We confirm that theoretical results are in good agreement with direct numerical simulations. Author

N92-11884# National Inst. for Fusion Science, Nagoya (Japan).
**FLUID DESCRIPTION OF PONDEROMOTIVE FORCE
 COMPATIBLE WITH THE KINETIC ONE IN A WARM PLASMA**

HITOSHI HOJO (Tsukuba Univ. (Japan).), TOMOKO OGAWA (Kyushu Univ., Fukuoka (Japan).), and MITSUO KONO (Kyushu Univ., Fukuoka, Japan) Jul. 1991 11 p Sponsored in part by Ministry of Education, Science and Culture

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(ISSN 0915-633X)

(NIFS-100; AD-B158804L; DE91-751077) Avail: CASI HC A03/MF A01

The ponderomotive effects of electromagnetic wave fields are of great practical importance in such cases as radio frequency (RF) stabilization, RF-induced transport in magnetically confined plasmas, etc. Theoretically, however, there are still discrepancies among expressions derived by a number of authors. Attention is restricted to the discrepancy between fluid and kinetic expressions of the ponderomotive force often found in literature dealing with warm plasma. Where it stems from and how it is resolved are discussed. Author

N92-11885# National Inst. for Fusion Science, Nagoya (Japan). **ROTATIONS OF BULK IONS AND IMPURITIES IN NON-AXISYMMETRIC TOROIDAL SYSTEMS**

NORIYOSHI NAKAJIMA and MASAO OKAMOTO Jul. 1991 21 p Submitted for publication (ISSN 0915-633X)

(NIFS-102; AD-B158808L; DE92-750966) Avail: CASI HC A03/MF A01

Neoclassical rotations are studied theoretically for a plasma consisting of electrons, bulk ions, and impurities in nonaxisymmetric toroidal systems. Impurity ions are assumed to lie in the Pfirsch-Schlueter collisionality regime. The results include the case of tokamaks. It is found that the rotations of impurities are generally different from those of bulk ions. The difference comes from mainly the different diamagnetic flows between bulk ion and impurities. In the $1/\delta$ regime or banana regime, the gradient of bulk ion temperature may be another cause for the different rotations between two species. However, in the region where the configuration is far from the axisymmetry, the cause of different rotations is just the different diamagnetic flows. As the poloidal rotations depend on the radial electric field contrary to the axisymmetric system, a relationship, which does not include the radial electric field, can be derived between poloidal and toroidal rotations. By estimating this relationship based on the measured rotations, the present neoclassical theory can be validated without knowledge of radial electric field. Author

N92-12707# National Inst. for Fusion Science, Nagoya (Japan). **MAGNETOHYDRODYNAMIC CELLULAR AUTOMATA**

TADATSUGU HATORI Feb. 1990 26 p Sponsored in part by Ministry of Education, Science and Culture (ISSN 0915-633X)

(NIFS-16) Avail: CASI HC A03/MF A01

There has been a renewal of interest in cellular automata, partly because they give an architecture for a special purpose computer with parallel processing optimized to solve a particular problem. The lattice gas cellular automata are briefly surveyed, which were recently developed to solve partial differential equations such as hydrodynamics or magnetohydrodynamics. A new model is given here to implement the magnetic Lorentz force in a more deterministic and local procedure than the previous one. Author

N92-12708# National Inst. for Fusion Science, Nagoya (Japan). **MAGNETIC FIELD STRUCTURE NEAR THE PLASMA BOUNDARY IN HELICAL SYSTEMS AND DIVERTOR TOKAMAKS**

KAZUNOBU NAGASAKI (Kyoto Univ. (Japan).) and KIMITAKA ITOH (Kyoto Univ., Uji, Japan) Feb. 1990 52 p Sponsored in part by Ministry of Education (ISSN 0915-633X)

(NIFS-17) Avail: CASI HC A04/MF A01

The magnetic field structure of the scrape off layer (SOL) region in both helical systems and divertor tokamaks is studied numerically by using model fields. The connection length of the field line to the wall is calculated. In helical systems, the connection length has a logarithmic dependence on the distance from the outermost magnetic surface or from the residual magnetic islands. The effect of axisymmetric fields on the field structure is also determined. In divertor tokamaks, the connection length also has logarithmic properties near the separatrix. Even with the perturbations, which

resonate to rational surfaces near the plasma boundary, are added, logarithmic properties still remain. We compare the connection length of torsatron/helical heliotron systems with that of divertor tokamaks. It is found that the former is shorter than the latter by one order of magnitude with similar aspect ratio. Author

N92-13796# Department of Energy, Washington, DC.

WORLD PROGRESS TOWARD FUSION ENERGY

J. F. CLARKE Sep. 1989 20 p Presented at the 14th World Energy Conference, Montreal (Canada), 17-22 Sep. 1989 (DE90-625427; INIS-MF-12547; CONF-890901) Avail: CASI (US Sales Only) HC A03/MF A01

This paper will describe the progress in fusion science and technology from a world perspective. The paper will cover the current technical status, including the understanding of fusion's economic, environmental, and safety characteristics. Fusion experiments are approaching the energy breakeven condition. An energy gain (Q) of 30 percent has been achieved in magnetic confinement experiments. In addition, temperatures required for an ignited plasma ($T_i = 32$ KeV) and energy confinements (about 75 percent of that required for ignition) have been achieved in separate experiments. Two major facilities have started the experimental campaign to extend these results and achieve or exceed $Q = 1$ plasma conditions by 1990. Inertial confinement fusion experiments are also approaching thermonuclear conditions and have achieved a compression factor 100-200 times liquid D-T. Because of this progress, the emphasis in fusion research is turning toward questions of engineering feasibility. Leaders of the major fusion R and D programs in the European Community (EC), Japan, the United States, and the U.S.S.R. have agreed on the major steps that are needed to reach the point at which a practical fusion system can be designed. The United States is preparing for an experiment to address the last unexplored scientific issue, the physics of an ignited plasma, during the late 1990's. The EC, Japan, U.S.S.R., and the United States have joined together under the auspices of the International Atomic Energy Agency (IAEA) to jointly design and prepare the validating R&D for an international facility, the International Thermonuclear Experimental Reactor (ITER), to address all the remaining scientific issues and to explore the engineering technology of fusion around the turn of the century. DOE

N92-14843# Nagoya Univ. (Japan). Plasma Science Center. **NEW NON-AXISYMMETRIC EIGENMODES ASSOCIATED WITH AN EDGE PLASMA LAYER**

KAORU YAMANAKA (University of Industrial Technology, Kanagawa, Japan) and RYO SUGIHARA Dec. 1989 24 p (DE90-798727; PSC-5) Avail: CASI (US Sales Only) HC A03

Effects of a rarefied plasma layer surrounding a cylindrical main plasma on Alfvén waves are investigated. The plasma is approximated with a two-step density profile and is assumed to be surrounded with a conducting wall. When the Alfvén resonance exists inside the rarefied plasma layer, two new modes are generated. One has its maximum of the wave intensity at the wall, is thus similar to a surface wave and the other is a short of a coaxial mode. These results are re-examined in a diffuse boundary plasma and the presence of these modes is confirmed. DOE

N92-14844# National Inst. for Fusion Science, Nagoya (Japan). **CONCEPTUAL DESIGN OF D-HE-3 FRC REACTOR ARTEMIS**

H. MOMOTA (National Inst. for Fusion Science, Nagoya (Japan).), A. ISHIDA (Niigata Univ. (Japan).), Y. KOHZAKI (Institute for Future Technology, Tokyo (Japan).), G. H. MILEY (Illinois Univ., Urbana.), S. OHI (Osaka Univ. (Japan).), M. OHNISHI (Kyoto Univ. (Japan).), K. YOSHIKAWA (Kyoto Univ. (Japan).), K. SATO (Himeji Inst. of Tech. (Japan).), L. C. STEINHAEUER (Spectra Technology, Inc., Bellevue, WA.), Y. TOMITA et al. Jul. 1991 45 p Sponsored by Ministry of Education, Science and Culture and DOE (ISSN 0915-633X)

(NIFS-101; AD-B158807L) Avail: CASI HC A03/MF A01

A comprehensive design study of the D-He-3 fueled Field Reversed Configuration (FRC) reactor ARTEMIS is carried out for the purpose of proving its attractive characteristics and clarifying

the critical issues for a commercial fusion reactor. The FRC burning plasma is stabilized and sustained in a steady equilibrium by means of a preferential trapping of D-He-3 fusion-produced energetic protons. A novel direct energy converter for 15MeV protons is also presented. On the bases of a consistent scenario of the fusion plasma production and simple engineering, a compact and simple reactor concept is presented. The design of the D-He-3 FRC power plant definitely offers the most attractive prospect for energy development. It is environmentally acceptable in view of radioactivity and fuel resources; and the estimated cost of electricity is low compared to a light water reactor. Critical issues concerning physics or engineering for the development of the D-He-3 FRC reactor are clarified. Author

N92-15755# National Inst. for Fusion Science, Nagoya (Japan).
DESIGN SCALINGS AND OPTIMIZATIONS FOR SUPER-CONDUCTING LARGE HELICAL DEVICES
 K. YAMAZAKI (National Inst. for Fusion Science, Nagoya (Japan).), O. MOTQJIMA (National Inst. for Fusion Science, Nagoya (Japan).), M. ASAO (Kobe Steel Ltd., Japan), M. FUJIWARA (National Inst. for Fusion Science, Nagoya (Japan).), and A. IYOSHI May 1990 45 p
 (ISSN 0915-633X)
 (NIFS-30) Avail: CASI HC A03/MF A01

Scalings of plasma configurations and engineering device parameters for I equals 2 helical systems with continuous coils are derived from a wide range of computations. Using these scalings, typical optimized designs of heliotron/torsatron experimental devices with NbTi superconducting (SC) coils are obtained after maximizing a fusion product $n \tau T$ within both physics and engineering constraints. Optimization studies have been carried out for the next-generation Large Helical Device (LHD) having a major radius of approx. 4 m and magnetic field of approx. 4 Tesla, in which to demonstrate a divertor concept is one of key experiments. These studies clarified that higher gamma c (helical coil pitch parameter) configurations (gamma c approx. greater than 1.25) with a larger plasma minor radius are not acceptable from the requirement of the clean divertor configuration. More compact lower-m systems (m approx. less than 8) are bounded by the equilibrium beta limit of the plasma and the stability limit of the SC coil current due to higher maximum magnetic field strength. Larger-aspect-ratio larger-m systems (m approx. greater than 12, gamma c is approx. 1.2-1.3) with better neoclassical confinement properties are not effective because of lower stability beta and a narrower clearance between the divertor layer and the wall. The divertor clearance becomes more severe in normal-conducting (NC) designs than in SC systems, and more than 5-second plasma operations are not possible. An I equals 2/m equals 10/gamma equals 1.2 SC system is found as one of optimized high $n \tau T$ configurations for 4m/4T next-generation experiments with respect to the high-beta requirement, the clean divertor installation, the SC coil engineering and the cost optimization. Author

N92-15756# National Inst. for Fusion Science, Nagoya (Japan).
PLASMA SPECTROSCOPY AND ATOMIC PROCESSES
 Sep. 1990 180 p Workshop held in Nagoya, Japan, 14-15 May 1990
 (DE91-767928; NIFS-PROC-4; CONF-9005341) Avail: CASI HC A09/MF A02

The papers from the workshop held at the Data and Planning Center of the National Institute for Fusion Science (NIFS) are presented. The 18 papers are discussed individually. The following topics are discussed: plasma spectroscopy, high temperature plasmas, highly charged ions, two electron systems, and muon catalyzed fusion. DOE

N92-15771# Japan Atomic Energy Research Inst., Tokyo.
THE ENERGY CONFINEMENT SCALING BASED ON MICROTURBULENCE TRANSPORT AND NEOCLASSICAL CONDUCTIVITY IN A TOKAMAK
 MASATOSHI YAGI (Japan Atomic Energy Research Inst., Naka.) Mar. 1991 15 p
 (DE91-508053; JAERI-M-91-022) Avail: CASI HC A03/MF A01

Based on the neoclassical electric conductivity and the anomalous transport models due to trapped electron modes and ion temperature gradient modes, the scaling law of the global energy confinement time in a tokamak has been theoretically studied, under the electron temperature profile constraint. The entropy production rate method, developed by W.M. Tang, has been employed to evaluate the electron temperature at the magnetic axis. The calculations has been performed in the wide range of the surface safety factor $q(\text{sub } a)$ of 2 to 7 and the inverse aspect ratio a/R of 0.2 to 0.6. Results are $\tau(\text{sub } E)(\text{infinity})n(\text{sub } e)q(\text{sub } a)(\text{exp } 0.9)a(\text{exp } 0.9)R(\text{exp } 1.9)B(\text{exp } -0.3)$ for joule heated plasmas and $\tau(\text{sub } E)(\text{infinity})n(\text{sub } e)(\text{exp } 0.6)l(\text{sub } p)(\text{exp } 1.16)a(\text{exp } 0.15)R(\text{exp } 1.7)B(\text{exp } -0.36)P(\text{exp } -0.6)$ for additionally heated L-mode plasmas, respectively. The trapped particle effect, or neoclassical effect, on electric conductivity has been shown to increase the dependence of $q(\text{sub } a)$ on $\tau(\text{sub } E)$, compared with the results for Spitzer conductivity case. Both scaling laws for joule and additionally heated plasmas are similar to those obtained in experiments. DOE

N92-15772# Japan Atomic Energy Research Inst., Tokyo.
VACUUM COMPONENT SUBSYSTEM OF TV THOMSON SCATTERING SYSTEM IN JFT-2M
 TOMIO SHIINA (Japan Atomic Energy Research Inst., Tokyo.), TOSHIHIKO YAMAUCHI (Japan Atomic Energy Research Inst., Naka.), ATSUSHI FUJISAWA (Japan Atomic Energy Research Inst., Tokyo.), OSAMU HANAWA (Japan Atomic Energy Research Inst., Tokyo.), D. DIMOCK (Japan Atomic Energy Research Inst., Tokyo.), AKIRA TAKAHASHI (Japan Atomic Energy Research Inst., Tokyo.), and SHINJI INOMATA Mar. 1991 22 p In JAPANESE; ENGLISH summary
 (DE91-508079; JAERI-M-91-030) Avail: CASI HC A03/MF A01

The vacuum component subsystem, which is one of six subsystems in the TV Thomson scattering (TVTS) system for the JFT-2M tokamak, is completed under a US-JAPAN cooperative program. This subsystem is composed of top and bottom flanges, side flange, beam dump, viewing dump and so on. These components are fitted in the existing 13-point Thomson scattering system as well as the TVTS optics newly developed by Princeton Plasma Physics Laboratory (PPPL) in the USA. A new feedback system of laser beam alignment was designed and developed. DOE

N92-15773# Japan Atomic Energy Research Inst., Tokyo.
THE ROLE OF INTEGER-MODE RATIONAL SURFACE ON PEAKED PROFILE FORMATION IN TOROIDAL ROTATION VELOCITY AND ION TEMPERATURE
 YOSHIHIKO KOIDE (Japan Atomic Energy Research Inst., Tokyo.), SHIN-ICHI ISHIDA (Japan Atomic Energy Research Inst., Tokyo.), and AKIRA SAKASAI (Japan Atomic Energy Research Inst., Naka.) Mar. 1991 13 p
 (DE91-508084; JAERI-M-91-041) Avail: CASI HC A03/MF A01

A particular role of integer-mode rational surfaces on the formation of peaked $T_{\text{sub } i}(r)$ and $V_{\text{sub } t}(r)$ is observed. In the case of JT-60 hot-ion regime, the plasma spontaneously changes its peaking region from the inside of a $q=2$ surface to that of a broader $q=3$ surface. DOE

N92-15774# Japan Atomic Energy Research Inst., Tokyo.
CONTROL OF THE PLASMA CONFIGURATION IN ITER
 RYUJI YOSHINO (Japan Atomic Energy Research Inst., Tokyo.), SATOSHI NISHIO (Japan Atomic Energy Research Inst., Tokyo.), MASAYOSHI SUGIHARA (Japan Atomic Energy Research Inst., Naka.), and KICHIRO SHINYA Mar. 1991 20 p
 (DE91-508093; JAERI-M-91-049) Avail: CASI HC A03/MF A01

Control of the plasma configuration in ITER is investigated. The multivariable noninteracting control method is proposed as one of the possible control algorithms for the plasma shape control. The relation between the control variables and the poloidal magnetic field coil currents is essential for investigating a feedback matrix gain, and is estimated for an ITER plasma. Control of the horizontal position of a plasma is investigated at the early buildup phase just after the breakdown. Poloidal field coil power supplies

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of 20kV and the installation of invessel coils are recommended to obtain the vertical magnetic field required for the plasma current rampup rate of 1MA/s. DOE

N92-15775# National Lab. for High Energy Physics, Tsukuba (Japan).

COMMENTS ON CRYSTAL ACCELERATORS AT KEK LIGHT SOURCES

B. NEWBERGER Jan. 1991 11 p
(DE91-508199; KEK-90-19) Avail: CASI HC A03/MF A01

We consider several concepts which have been proposed for particle acceleration in crystalline solids in terms of proof-of-principle experiments using available sources of light from the VUV to X ray. Direct evidence of acceleration does not appear to be observable but, in some cases, it may be possible to infer the presence of the waves which can provide a gradient. DOE

N92-15776# Japan Atomic Energy Research Inst., Tokyo.
ANALYSIS OF OPERATION AND MAINTENANCE IN JT-60
KIYOTSUGU ARAKAWA, MUNETAKA SEIMIYA, and MASATSUGU SHIMIZU Dec. 1990 63 p In JAPANESE; ENGLISH summary Prepared in cooperation with Japan Atomic Energy Research Inst., Ibaraki

(DE91-780248; JAERI-M-90-226) Avail: CASI HC A04/MF A01

Operation in a large tokamak device, JT-60, was carried out for about five years since its first plasma was obtained in April of 1985. The total number of shots amounts to about 9000, including both ohmic heating and additional heating shots. Many troubles were reported in this period. The trouble analysis gives us a lot of useful information on the availability and reliability of the JT-60 facilities. Some effective countermeasures have been developed to reduce the troubles and to raise the operational efficiency. The JT-60 has been under construction for its upgrade since November of 1989. The results of trouble analysis will be useful for us to plan the operation and maintenance of the JT-60 upgrade and the design of the Fusion Experimental Reactor. DOE

N92-16827# Japan Atomic Energy Research Inst., Tokyo.
PRODUCTION OF A HIGH PROTON YIELD BEAM IN A SEMI-CYLINDRICAL PLASMA GENERATOR

KAZUHIRO WATANABE, MASANORI ARAKI, MASAYUKI DAIRAKU, HIROSHI HORIIE, YOSHIHIRO OHARA, YOSHIKAZU OKUMURA, SHIGERU TANAKA, and KENJI YOKOYAMA Dec. 1990 65 p In JAPANESE; ENGLISH summary Prepared in cooperation with Japan Atomic Energy Research Inst., Ibaraki
(DE91-780210; JAERI-M-90-212) Avail: CASI HC A04/MF A01

A semi-cylindrical plasma generator whose dimensions are 34 cm in inner diameter and 129 cm in length has been developed for use in JAPAN-FRANCE collaborative experiment on the energy recovery. The 3D computer code for the magnetic field distribution and the electron orbits was utilized to obtain a high proton ratio and a good uniformity of plasma. Plasma spatial uniformities were measured with Langmuir probes. The plasma uniformity of ± 5 percent was obtained in the measured region of 8 cm x 100 cm at the arc current of 900 A. Hydrogen beams were extracted from a central area of 7 cm x 27 cm and ion species were measured by the Doppler shifted spectroscopy. The results show that the proton ratio became higher: (1) at higher arc current; (2) at the magnetic field distributions which confine the electrons strongly; and (3) at the magnetic field distribution in which the electrons orbits are far from the beam extraction region. The proton ratio of 93 percent was obtained in the case where the plasma uniformity was as good as ± 5 percent in the area of 8 cm x 100 cm. The highest proton ratio of 95 percent was obtained with a strongly linked magnetic field distribution. DOE

N92-16828# Nagoya Univ. (Japan). Plasma Science Center.
EXPERIMENTAL AND THEORETICAL STUDIES OF SELF-ORGANIZATION IN A REVERSED-FIELD PINCH
H. ARIMOTO, T. AMANO, A. NAGATA, S. MASAMUNE, A. NAKAMURA, H. OSHIYAMA, T. TSUKISHIMA, and K. I. SATO Nov. 1990 22 p
(DE91-780231; PSC-12) Avail: CASI HC A03/MF A01

In STP-3M reversed field pinch (RFP), MHD behavior in the intermittent increase of a toroidal magnetic flux (discrete dynamo) in normal-theta (theta = edge poloidal field/average toroidal field) regime has been studied with the help of 3-D MHD simulations, and the following picture has been provided. m (poloidal mode number) = 1 modes grow as the precursor of a dynamo. These m = 1 modes interact each other through overlap of magnetic islands and subsequent reconnection of field lines, and, as a result, m = 0 modes with low n (toroidal mode number) are excited. As these m = 0 modes grow, enhancement of the toroidal magnetic flux takes place. A region of stochastic magnetic field line expands over the core regime of a plasma, as the m = 0 modes grow. DOE

N92-16829# Japan Atomic Energy Research Inst., Tokyo.
SURVEY OF FUSION REACTOR LIQUID METAL BLANKET DEVELOPMENT

KOICHI MAKI (Japan Atomic Energy Research Inst., Ibaraki.) Dec. 1990 28 p In JAPANESE; ENGLISH summary
(DE91-780245; JAERI-M-90-222) Avail: CASI HC A03/MF A01

Liquid metal blanket concepts designed up to now were surveyed. From the present survey, issues and present status in neutronics studies are explained. The extent of survey is restricted with in not only a field of self-cooled liquid metal blankets but also that of water or gas cooled liquid metal blankets. From the present survey, following results are obtained. Lead neutron multiplier is not superior to beryllium neutron multiplier in neutron multiplication for tritium breeding blankets in fusion reactors. Lead is much more abundant than beryllium in material resource. Utilizing lead as neutron multipliers is therefore significant in the future of fusion reactor development. From the viewpoint of neutronics, liquid metal blankets leave possibilities to achieve a target value of tritium breeding ratio by skillfully devising blanket structure. DOE

N92-16840# Nagoya Univ. (Japan). Plasma Science Center.
PARTICLE TRAJECTORIES IN CROSS-FIELD ACCELERATION BY AN ELECTROSTATIC WAVE TRANSVERSE TO UNIFORM MAGNETIC FIELD

YOSHINOSUKE TERASHIMA Jan. 1991 23 p
(DE91-521937; PSC-13) Avail: CASI HC A03/MF A01

Particle trajectories in the wave frame are expressed in an integral form which elucidates the roles of the applied electrostatic wave field and of the induced $V(\text{sub } p) \times B$ field. Both the non-relativistic and relativistic cases are treated. In each case, the energy integral is shown to exist and a criterion for transition from trapping to detrapping is obtained, and thereby the optimum value of energy gain is deduced. It is shown that, when the $E \times B$ velocity due to the wave field in the wave frame, $v(\text{sub } E)$, is less than the light speed, the Lorentz factor of an accelerated particle, gamma (v), is almost limited by gamma (sub c) = $(1 - v(\text{sub } E)^2/c^2)^{-1/2}$, while for $v(\text{sub } E)$ greater than c, gamma (v) possibly increases linearly with time. DOE

N92-16841# National Inst. for Fusion Science, Nagoya (Japan).
APPLICATION OF INTERMEDIATE FREQUENCY RANGE FAST WAVE TO JIPP T-IIU PLASMA

T. SEKI, R. KUMAZAWA, and Y. TAKASE Sep. 1990 46 p
(DE91-521940; NIFS-48) Avail: CASI HC A03/MF A01

A series of experiments using a newly constructed 130 MHz RF system has been conducted on the JIPP T-IIU tokamak since 1989. It is predicted theoretically that the fast wave in this range of frequency weakly interacts with particles. Though weak, two mechanisms of wave absorption were identified in the experiment: electron Landau/transit-time damping and 3rd ion cyclotron harmonic heating. The former has an intimate connection with fast wave current drive and the latter can provide a new regime of plasma heating or a possible method of controlling transport of alpha particles. It was found that the efficiency of the 3rd cyclotron heating is improved by using it in the combination with NBI and ICRF heating. The heating efficiency obtained is as high as that of conventional heating. The experimental results are also analyzed on the basis of a theory of the global wave which takes into

account wave particle interactions. These mechanism of wave particle interactions are competing with each other as they will be under more realistic reactor conditions. DOE

N92-16842# National Inst. for Fusion Science, Nagoya (Japan).
BOOTSTRAP CURRENTS IN STELLARATORS AND TOKAMAKS
MASAO OKAMOTO and NORIYOSHI NAKAJIMA Sep. 1990 19 p
(DE91-521943; NIFS-53) Avail: CASI HC A03/MF A01

The remarkable feature of the bootstrap current in stellarators is its strong dependence on the magnetic field configuration. Neoclassical bootstrap currents in a large helical device of torsatron/heliotron type ($L = 2$, $M = 10$, $R = 4$ m, $B = 4$ T) is evaluated in the banana ($1/\nu$) and the plateau regime. Various vacuum magnetic field configurations are studied with a view to minimizing the bootstrap current. It is found that in the banana regime, shifting of the magnetic axis and shaping of magnetic surfaces have a remarkable influence on the bootstrap current; a small outward shift of the magnetic axis and vertically elongated magnetic surfaces are favorable for a reduction of the bootstrap current. It is noted, however, that the ripple diffusion in the $1/\nu$ regime has opposite tendency to the bootstrap current; it increases with the outward shift and increases as the plasma cross section is vertically elongated. The comparison will be made between bootstrap currents in stellarators and tokamaks. DOE

N92-16843# National Inst. for Fusion Science, Nagoya (Japan).
PEAKED-DENSITY PROFILE MODE AND IMPROVED CONFINEMENT IN HELICAL SYSTEMS
K. ITOH and SANAE ITOH Oct. 1990 13 p
(DE91-521945; NIFS-54) Avail: CASI HC A03/MF A01

The difference in the effect of the peaked density profile on the improved transport between tokamaks and toroidal-helical systems is discussed. Based on the theory that the rotational shear causes the inward pinch in tokamaks, the magnitude of the possible inward pinch is estimated. Owing to the strong damping of the rotation due to the helical ripple, the anomalous inward pinch would be small. This may be consistent with recent observation in the Heliotron E device that the density peakedness of $n(0)/\langle n \rangle = 5$ does not correspond to the improved confinement. DOE

N92-16844# National Inst. for Fusion Science, Nagoya (Japan).
IMPROVED MODES AND THE EVALUATION OF CONFINEMENT IMPROVEMENT
SANAE ITOH, HIKOSUKE MAEDA, and YUKITOSHI MIURA Oct. 1990 26 p
(DE91-521947; NIFS-57) Avail: CASI HC A03/MF A01

Various improved confinement modes in tokamak devices are surveyed and their characteristics are reviewed. To search for the potentiality of the fusion core plasma in the reactor, an examination of the core performance has been made. The fusion product near the ignition condition, when Q is large, is used for the evaluation. The dilution of the fuel ion and the profile effect are simultaneously examined together with the obtained $\tau_{\text{sub E}}$. Because of fuel dilution and bulk radiation, good performance does not always correspond to the mode with long $\tau_{\text{sub E}}$. If the time evolution is taken into account, the problem becomes more serious. Further research to control the fuel purity is needed to ensure the long pulse operation. DOE

N92-16845# National Inst. for Fusion Science, Nagoya (Japan).
THE SIGNIFICANCE OF MEDIUM- OR SMALL-SIZE DEVICES IN FUSION RESEARCH
HIKOSUKE MAEDA (Japan Atomic Energy Research Inst., Tokai.) and SANAE ITOH Oct. 1990 23 p
(DE91-521950; NIFS-58) Avail: CASI HC A03/MF A01

The significance of medium and small size devices is reviewed using the example of the ITER Physics R and D. It is noted that the heat flux density expected in a fusing plasma will become large and it is not self-evident that one can use current energy confinement time scalings to predict ITER performance. The

confinement of plasma is considered to be related to heat, momentum, and mass transport problems in a nonlinear, non-equilibrium system with a finite source and dissipation. Therefore, recent progress in fluid dynamics, especially where basic experiments are unveiling modes of heat and mass transport in the nonlinear non-equilibrium system (including conditions of transition to turbulence), is referred to frequently. Hence, systematic and basic research along the same lines is necessary in medium and small devices in order to develop further insight into the physics of plasma confinement. DOE

N92-16846# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
CONTROL OF THE MAGNETIC CONFIGURATION IN THE HELIOTRON-E DEVICE
T. MIZUUCHI, H. MATSUURA, and A. KOMORI Jul. 1990 19 p
(DE91-790809; PPLK-R-48) Avail: CASI HC A03/MF A01

The magnetic configuration of the Heliotron E device was controlled by adding auxiliary toroidal and/or vertical fields. The changes in the plasma edge and the 'divertor trace' were experimentally studied by using a double probe, calorimeters, a thermal Li beam probe and a laser Thomson scattering system. The variation of the vacuum configuration was also confirmed by the 'stellarator diode method' with a small hot cathode. It was found that the observed change in the edge region basically agreed with that expected from the line tracing calculation. DOE

N92-16847# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
TRAPPED PARTICLE CONFINEMENT STUDIES IN $L = 2$ TORSATRONS FOR ADDITIONAL HELICAL COILS, RADIAL ELECTRIC FIELD, AND FINITE BETA EFFECT
A. KATO, Y. NAKAMURA, and MASAHIRO WAKATANI Jul. 1990 40 p
(DE91-790810; PPLK-R-49) Avail: CASI HC A03/MF A01

Torsatrons are studied to improve the high energy trapped particle confinement with additional helical coils. The winding laws are selected in two ways. One is to realize 'sigma - optimization' by the additional helical coils, but this approach loses magnetic well region. The other selection is to produce or deepen the magnetic well by the additional helical coils. Helical coils are usable to this end. In this case the improvement of the trapped particle confinement depends on magnetic axis position. A radial electric field producing sheared rotational motion is also considered to improve the trapped particle confinement in a standard torsatron. By excluding cancellation between $E \times B$ and $\text{del}(B)$ drift motion occurred for the parabolic potential profiles, all deeply trapped particles can be confined in the central region. Degradation of the trapped particle confinement by the Shafranov shift is mitigated by shifting the magnetic axis inside in the vacuum configuration. DOE

N92-16848# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
STUDY OF TWO-DIMENSIONAL INTERCHANGE TURBULENCE
HIDEO SUGAMA and MASAHIRO WAKATANI Apr. 1990 42 p
(DE91-790811; PPLK-R-47) Avail: CASI HC A03/MF A01

An eddy viscosity model describing enstrophy transfer in 2D turbulence is presented. This model provides an equation for the energy spectral function $F(k)$ as a function of the energy input rate to the system per unit wavenumber, $\gamma_{\text{sub s}}(k)$. In the enstrophy-transfer inertial range, $F(k)$ varies as $k(\text{exp } -3)$ is predicted by the model. The eddy viscosity model is applied to the interchange turbulence of a plasma in shearless magnetic field. Numerical simulation of the 2D interchange turbulence demonstrates that the energy spectrum in the high wavenumber region is well described by this model. The turbulent transport driven by the interchange turbulence is expressed in terms of the Nusselt number Nu , the Rayleigh number Ra and Prandtl number Pr in the same manner as that of thermal convection problem. When we use the linear growth rate for $\gamma_{\text{sub s}}(k)$, our theoretical model predicts that Nu varies as $(Ra \cdot Pr)(\text{exp } 1/2)$ for a constant background pressure gradient and Nu varies as $(Ra \cdot Pr)(\text{exp } 1/3)$ for a self-consistent background pressure profile with

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the stress-free slip boundary conditions. The latter agrees with our numerical result showing Nu varies as $Ra(\exp 1/3)$. DOE

N92-16849# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
CONFINEMENT SCALING STUDIES OF RF- AND NEUTRAL-BEAM HEATED CURRENTLESS HELIOTRON E PLASMAS

Y. TAKEIRI, F. SANO, and M. SATO Feb. 1990 43 p
 (DE91-790812; PPLK-R-46) Avail: CASI HC A03/MF A01

Parametrical scaling studies of RF- and neutral-beam-heated currentless Heliotron E plasmas have been performed. Parametrical local electron transport analyses show that the electron energy transport of the ECH plasmas has nearly the same values as the neoclassically predicted ones inside the $2/3$ radius, while the NBI and the ICRF plasmas are dominated by the anomalous electron transport in the whole region. Scaling studies on global energy confinement time reveal that the ECH, NBI, and ICRF plasmas obey nearly the same scaling that is characterized as continuous power degradation and favorable positive density dependence. The global energy confinement time is thought to be influenced by the anomalous transport in the peripheral plasma region in common with the ECH, NBI, and ICRF plasmas, although the core plasma properties such as the local electron transport seem to be different between these plasmas. DOE

N92-16850# National Inst. for Fusion Science, Nagoya (Japan).
SELF-ORGANIZING MAGNETOHYDRODYNAMIC PLASMA

T. SATO, R. HORIUCHI, K. WATANABE, T. HAYASHI, and K. KUSANO Sep. 1990 16 p
 (DE91-790864; NIFS-52) Avail: CASI HC A03/MF A01

In a resistive magnetohydrodynamic (MHD) plasma, both the magnetic energy and the magnetic helicity dissipate with the resistive time scale. However, when sufficiently large free magnetic energy does exist, an ideal current driven instability is excited whereby magnetic reconnection is driven at a converging point of induced plasma flows which does exist in a bounded compressible plasma. At a reconnection point excess free energy (entropy) is rapidly dissipated by ohmic heating and lost by radiation, while magnetic helicity is completely conserved. The magnetic topology is largely changed by reconnection and a new ordered structure with the same helicity is created. It is discussed that magnetic reconnection plays a key role in the MHD self-organization process. DOE

N92-16860# Japan Atomic Energy Research Inst., Tokyo.
KINETIC DATABASE OF THE JT-60 TOKAMAK DURING 1985-1987 EXPERIMENTS

MITSURU KIKUCHI (Japan Atomic Energy Research Inst., Ibaraki.), KATSUJI KIKUCHI (Japan Atomic Energy Research Inst., Ibaraki.), TETSUO AOYAGI (Japan Atomic Energy Research Inst., Ibaraki.), and KEIJI TANI (Japan Atomic Energy Research Inst., Naka.) Mar. 1991 292 p
 (DE91-522095; JAERI-M-91-057) Avail: CASI HC A13/MF A03

Kinetic database during the ohmic and strong neutral beam heated discharges are analyzed for the discharges during 1985-1987 experimental period. The results are registered in the database system, DARTS, so that many scientists can access the JT-60 database. This manuscript describes the confinement properties of JT-60 plasmas and gives the shot list of all kinetic database during 1985-1987. The data analysis method and its limitation are also given so as to help the readers of the kinetic database in JT-60. DOE

N92-16861# Japan Atomic Energy Research Inst., Tokyo.
REPORT OF THE 1990 WORKSHOP ON PLASMA-MATERIALS INTERACTIONS FOR FUSION RESEARCH

Mar. 1991 194 p In JAPANESE; ENGLISH summary Workshop held in Tokyo, Japan, 10-11 Jul. 1990
 (DE91-522209; JAERI-M-91-050; CONF-9007220) Avail: CASI HC A09/MF A03

The aim of the workshop was to obtain future prospects for the activities of the Working Group, by discussing current problems in plasma-materials interactions relevant to fusion research. This

report contains all the 16 papers presented at the workshop, which are mainly concerned with problems in the first wall of large Tokamak devices, such as retention and release of hydrogen in carbon materials, sputtering, and problems in material data system. DOE

N92-23132# Japan Atomic Energy Research Inst., Tokyo.
CONCEPTUAL DESIGN OF FUSION EXPERIMENTAL REACTOR

YASUSHI SEKI (Japan Atomic Energy Research Inst., Naka.), HIDEYUKI TAKATSU (Japan Atomic Energy Research Inst., Naka.), and HIROMASA IIDA Aug. 1991 522 p In JAPANESE; ENGLISH summary
 (DE92-751036; JAERI-M-91-126) Avail: CASI HC A22/MF A04

Safety analysis and evaluation have been made for the FER (Fusion Experimental Reactor) as well as for the ITER (International Thermonuclear Experimental Reactor) which are basically the same in terms of safety. This report describes the results obtained in fiscal years 1988 - 1990, in addition to a summary of the results obtained prior to 1988. The report shows the philosophy of the safety design, safety analysis and evaluation for each of the operation conditions, namely, normal operation, repair and maintenance, and accident. Considerations for safety regulations and standards are also added. DOE

N92-23133# Japan Atomic Energy Research Inst., Tokyo.
FUSION GAIN DUE TO HIGH ENERGY IONS ACCELERATED BY ADDITIONAL HEATING

KIYOTAKA HAMAMATSU (Japan Atomic Energy Research Inst., Naka.), MASAFUMI AZUMI (Japan Atomic Energy Research Inst., Naka.), and ATSUSHI FUKUYAMA (Japan Atomic Energy Research Inst., Naka.) Oct. 1991 21 p In JAPANESE; ENGLISH summary
 (DE92-751038; JAERI-M-91-156) Avail: CASI HC A03/MF A01

In order to investigate a gain of fusion reaction caused by high energy ions, the ICRF wave propagation equation and the Fokker-Planck equation with the effects of particle acceleration due to the RF-electric field are numerically analyzed in a self-consistent manner. In the ICRF and NBI heated plasmas, the input power dependences of fusion output power of D-D, D-(sup 3)He and D-T reactions are calculated and compared with each other. As for the ICRF heating conditions, the higher harmonic resonance up to the third one and phase control of antenna currents are taken into account. To optimize the NBI heating condition on a fusion reaction, the beam energy needs to be exceeded the energy where the fusion cross section is maximum. In the case of ICRF heating, fast ions are accelerated beyond the several MeV by the velocity diffusion coefficient due to the RF-electric field in the Fokker-Planck equation. The ICRF heating condition does not affect the fusion output so seriously from this standpoint. As for the D-D reaction, however, the third harmonic resonance heating is more effective than the second one. Because, the fusion cross-section of D-D reaction has a maximum value at high energy range (3 to approximately 4 MeV) and the third harmonic resonance heating accelerates higher energy particles than the second one. On the other hand, in order to avoid the direct power loss by electron Landau damping in the wave propagation process, the phase difference of antenna currents needs to be inphase. DOE

N92-23135# Japan Atomic Energy Research Inst., Tokyo.
EVOLUTION OF MAGNETIC MOMENT DUE TO THE CYCLOTRON RESONANCE WITH FIELD RIPPLES IN A TOKAMAK

MASATOSHI TANAKA (Japan Atomic Energy Research Inst., Naka.) Oct. 1991 31 p In JAPANESE; ENGLISH summary
 (DE92-751058; JAERI-M-91-168) Avail: CASI HC A03/MF A01

Toroidal field ripples of tokamaks resonate under certain conditions with the cyclotron motion of charged particles streaming along the magnetic field lines. This resonance may yield the evolution of the magnetic moment, a good adiabatic invariant of the motion in magnetic fields. The equation of motion for the magnetic moment is discretized to a mapping which describes

the evolution of the magnetic moment across the successive resonances. On the basis of the mapping, derived is the linear stability of the motion in the phase space and the diffusion constant of the magnetic moment when the motion becomes stochastic.

DOE

**N92-23261# National Inst. for Fusion Science, Nagoya (Japan).
FEEDBACK CONTROL OF PLASMA EQUILIBRIUM WITH
CONTROL SYSTEM AIDED BY PERSONAL COMPUTER ON
THE JIPP T-IIU TOKAMAK**

T. TSUZUKI, K. TOI, and K. MATSUURA Apr. 1991 35 p In JAPANESE; ENGLISH summary
(DE92-750824; NIFS-MEMO-1) Avail: CASI HC A03/MF A01

A feedback control system aided by a personal computer is developed to maintain plasma position on the required position in the JIPP T-IIU tokamak. The personal computer enables adjustment of control parameters easily. In this control system, a control demand for driving the power supply of feedback controlled vertical field coils is composed to be proportional to a total plasma current. This system has been successfully employed throughout the discharge where the plasma current substantially changes from zero to hundreds of kiloamperes, because the feedback control can be done, being independent of the plasma current. The analysis of this feedback control system taken into account of digital sampling agrees well with the experimental results.

DOE

**N92-23264# Japan Atomic Energy Research Inst., Tokyo.
EVALUATION OF MODE PURITY OF ORDINARY AND
EXTRAORDINARY MODES BY FIXED ELLIPTICALLY
POLARIZED WAVE FOR ECH AND ECCD**

MIKIO SAIGUSA (Japan Atomic Energy Research Inst., Naka.) Aug. 1991 20 p
(DE92-750961; JAERI-M-91-131) Avail: CASI HC A03/MF A01

Mode separation ratio from an arbitrary elliptically polarized electromagnetic wave to an ordinary and an extraordinary modes on a plasma surface for oblique launch is evaluated quantitatively for designing an electron cyclotron current drive (ECCD) antenna. An optimized elliptical polarization for the wide range of injection angles and magnetic fields is firstly investigated for ECCD and ECH experiments.

DOE

**N92-23711# Japan Atomic Energy Research Inst., Tokyo.
CONCEPTUAL DESIGN OF FUSION EXPERIMENTAL
REACTOR (FER/ITER)**

HARUYUKI KIMURA (Japan Atomic Energy Research Inst., Naka.), MIKIO SAIGUSA (Japan Atomic Energy Research Inst., Naka.), and YASUSHI SAITOH Jun. 1991 99 p
(DE92-750949; JAERI-M-91-094) Avail: CASI HC A05/MF A02

Conceptual design of the Ion Cyclotron Wave (ICW) system for the FER and the Japanese contribution to the conceptual design of the International Thermonuclear Experimental Reactor (ITER) Ion Cyclotron Wave (ICW) system are presented. A frequency range of the FER ICW system is 50-85 MHz, which covers 2 omega (sub cT) heating, current drive by transit time magnetic pumping (TTMP) and 2 omega (sub cD) heating. Physics analyses show that the FER and the ITER ICW systems are suitable for the central ion heating and the burn control. The launching systems of the FER ICW system and the ITER high frequency ICW system are characterized by in-port plug and ridged-waveguide-fed 5x4 phased loop array. Merits of those systems are (1) a ceramic support is not necessary inside the cryostat and (2) remote maintenance of the front end part of the launcher is relatively easy. Overall structure of the launching system is consistent with radiation shielding, cooling, pumping, tritium safety and remote maintenance. The launcher has injection capability of 20 MW in the frequency range of 50-85 MHz with the separatrix-antenna distance of 15 cm and steep scrape-off density profile of H-mode. The shape of the ridged waveguide is optimized to provide desired frequency range and power handling capability with a finite element method. Matching between the current strap and the ridged waveguide is satisfactorily good. Thermal analysis of the Faraday shield shows that high electric conductivity low Z material such as beryllium should be chosen for a protection tile of the Faraday

shield. A thick Faraday shield is necessary to tolerate electromagnetic force during disruptions. R and D needs for the ITER/FER ICW systems are identified and gain from JT-60/60U ICRF experiments and operations are indicated in connection with them.

DOE

**N92-24893# National Inst. for Fusion Science, Nagoya (Japan).
PLASMA TRANSPORT SIMULATION MODELING FOR
HELICAL CONFINEMENT SYSTEMS**

K. YAMAZAKI and T. AMANO Aug. 1991 36 p
(DE92-768117; NIFS-104) Avail: CASI HC A03/MF A01

New empirical and theoretical transport models for helical confinement systems are developed based on the neoclassical transport theory including the effect of radial electric field and multi-helicity magnetic components, and the drift wave turbulence transport for electrostatic and electromagnetic modes, or the anomalous semi-empirical transport. These electron thermal diffusivities are compared with CHS (Compact Helical System) experimental data, which indicates that the central transport coefficient of the ECH plasma agrees with the neoclassical axisymmetric value and the transport outside the half radius is anomalous. On the other hand, the transport of NBI-heated plasmas is anomalous in the whole plasma region. This anomaly is not explained by the electrostatic drift wave turbulence models in these flat-density-profile discharges. For the detailed prediction of plasma parameters in a LHD (Large Helical Device), 3-D equilibrium/1-D transport simulations including empirical or drift wave turbulence models are carried out. These transport simulations suggests that the global confinement time of LHD is determined mainly by the electron anomalous transport near the plasma edge region rather than the helical ripple transport in the core region. Even if the ripple loss can be eliminated, the increase of the global confinement is 10 percent. However, the rise in the central ion temperature is more than 20 percent. If the anomalous loss can be reduced to the half level of the present scaling, like so-called 'H-mode' of the tokamak discharge, the neoclassical ripple loss through the ion channel becomes important even in the plasma core. The 5 percent radial inward shift of the plasma column with respect to the major radius is effective for improving plasma confinement and raising more than 50 percent of the fusion product by reducing this neoclassical asymmetric ion transport loss and increasing 10 percent in the plasma radius.

DOE

**N92-25486# Japan Atomic Energy Research Inst., Tokyo.
NEOCLASSICAL TRANSPORT ANALYSIS OF TITANIUM
IMPURITY IN PLASMAS WITH STRONGLY PEAKED DENSITY
PROFILES**

TOSHIO HIRAYAMA (Japan Atomic Energy Research Inst., Naka.), TATSUO SUGIE (Japan Atomic Energy Research Inst., Naka.), AKIRA SAKASAI (Japan Atomic Energy Research Inst., Naka.), RYUUJI YOSHINO (Japan Atomic Energy Research Inst., Naka.), and YUTAKA KAMADA (Japan Atomic Energy Research Inst., Naka.) Oct. 1991 20 p
(DE92-768107; JAERI-M-91-169) Avail: CASI HC A03/MF A01

The full neoclassical multi-ion calculation required for the interaction between titanium and light impurities like carbon and oxygen is presented. Intrinsic titanium impurity behavior in pellet fuelled plasmas was studied by applying the neoclassical impurity transport calculation to temporal evolutions of Ti 20 and Ti 21 spectroscopically observed. Ti impurity accumulates in the plasma core region, correlated with peaked density profile and the absence of sawtooth oscillation. Impurity accumulation is caused by a strong ion density gradient driving force and collisions with light impurities, as the neoclassical impurity transport theory predicts. This impurity behavior is well described by the combination of reduced anomalous diffusion and neoclassical transport in the plasma interior. The reduced anomalous diffusion at the central region inside the $q = 1$ is estimated to be 0.2 m(sup 2)/s. The outer zones continue to be dominated by anomalous transport.

DOE

**N92-25487# National Inst. for Fusion Science, Nagoya (Japan).
THOUGHT ANALYSIS ON RELAXATION AND GENERAL
PRINCIPLE TO FIND RELAXED STATE**

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YOSHIOMI KONDOH (Gunma Univ., Maebashi, Japan) Sep. 1991 14 p
(DE92-768112; NIFS-109) Avail: CASI HC A03/MF A01

A thought analysis on relaxation is presented to lead to a general principle applicable to all dynamical systems to find the relaxed state. The general principle is applied to the energy relaxation of the magnetohydrodynamic (MHD) plasma to lead to the relaxed state of $(\text{del operator}) \times B = \lambda B$ and the mode transition condition without using the concept of helicity. The present theory permits the quasi-steady energy flow through the boundary surface and leads to a more general relaxed state for plasmas having spatial dependent resistivity, that connects directly to the experimental fact of $j = 0$ near the wall. DOE

N92-25488# National Inst. for Fusion Science, Nagoya (Japan).
NEOCLASSICAL TRANSPORT ANALYSIS IN THE BANANA REGIME ON LARGE HELICAL DEVICE (LHD) WITH THE DKES CODE

Y. OGAWA, T. AMANO, N. NAKAJIMA, Y. OHYABU, K. YAMAZAKI, S. P. HIRSHMAN, W. I. VANRIJ, and K. C. SHAING Sep. 1991 47 p
(DE92-768113; NIFS-108) Avail: CASI HC A03/MF A01

Neoclassical transport in the banana regime has been analyzed with the Drift Kinetic Equation Solver (DKES) code for the Large Helical Device (LHD). It is found that in a $1/\nu$ regime, diffusion coefficients change by one order of magnitude for various configurations of LHD (-0.2 m less than or equal to Δ less than or equal to 0 m, 0 percent less than or equal to B_q less than or equal to 200 percent, -0.1 less than or equal to α less than or equal to 0.1), depending on the structure of the helical magnetic ripple. The neoclassical transport calculated with the DKES code is quantitatively, in good agreement with multi-helicity theory formulated by Shaing and Hokin. Incorporating the multi-helicity effect into the diffusion coefficient, we have proposed an interpolation formula between the $1/\nu$ and ν regimes. When the ion temperature is increased at a fixed density of $n = 10(\text{exp } 20)$ m(exp -3), the ions undergo a transition from $1/\nu$ neoclassical transport to the ν regime when their temperature $T(\text{sub } i)$ becomes greater than 3 keV with radial electric potential $e\text{-}\phi_i$ comparable to the ion temperature $(e\text{-}\phi_i/T(\text{sub } i) \text{ approx. equal } 1)$. For the optimized configuration ($\Delta = -0.2$ m, $B_q = 100$ percent), the ion thermal diffusivity $\chi(\text{sub } i)$ has a maximum value of $\chi(\text{sub } i) \text{ approx. equal } 3.5$ m(exp 2)/s at a minor radius of $r/a \text{ approx. equal } 0.5$. The bootstrap current has been also studied, and the results have been comprehensively compared with the theory. At the collisionless limit with a moderate radial electric potential of $e\text{-}\phi_i/T(\text{sub } i) \text{ approx. equal } 1$, the DKES calculations evaluated for various configurations of LHD have supported the theoretical formula given by Shaing and Callen. At the collision frequency between the plateau and the banana regimes, where the analytic theory is not applicable, the bootstrap current might become larger than in the collisionless limit (by a factor of about two), depending on the radial electric fields. DOE

N92-25489# National Inst. for Fusion Science, Nagoya (Japan).
MACROSCALE PARTICLE SIMULATION OF EXTERNALLY DRIVEN MAGNETIC RECONNECTION

SADAYOSHI MURAKAMI and TETSUYA SATO Sep. 1991 34 p
(DE92-768114; NIFS-107) Avail: CASI HC A03/MF A01

Externally driven reconnection, assuming an anomalous particle collision model, is numerically studied by means of a 2.5D macroscale particle simulation code in which the field and particle motions are solved self-consistently. Explosive magnetic reconnection and energy conversion are observed as a result of slow shock formation. Electron and ion distribution functions exhibit large bulk acceleration and heating of the plasma. Simulation runs with different collision parameters suggest that the development of reconnection, particle acceleration and heating do not significantly depend on the parameters of the collision model. DOE

N92-25949# National Inst. for Fusion Science, Nagoya (Japan).
CHAOTIC PHENOMENA IN PLASMAS

Y. KAWAI (Kyushu Univ., Fukuoka, Japan) Aug. 1991 44 p
(DE92-768073; NIFS-MEMO-4) Avail: CASI HC A03/MF A01

It was recently recognized that research into various aspects of chaotic dynamics is growing rapidly as one of the premier areas in nonlinear science. The field of plasma physics is filled with nonlinear phenomena, so it is easy to see why the study of plasma is widespread in chaotic phenomena. Research on plasma chaos is being carried out in such areas as stochastic magnetic field and the chaotic orbit in a toroidal helical system. To review the present status of the research in plasma chaos and to elucidate the basic physics, a working group was organized in 1990 as a collaborative research effort of the National Institute for Fusion Science. This is the report of its activity in 1990. DOE

N92-28234# National Inst. for Fusion Science, Nagoya (Japan).
DEVELOPMENT OF NEGATIVE HEAVY ION SOURCES FOR PLASMA POTENTIAL MEASUREMENT

M. SASAO, Y. OKABE, A. FUJISAWA, H. IGUCHI, J. FUJITA, H. YAMAOKA, and M. WADA Oct. 1991 16 p
(DE92-782102; NIFS-112) Avail: CASI HC A03/MF A01

A plasma sputter negative ion source was studied for its applicability to the potential measurement of a fusion plasma. Both the beam current density and the beam energy spread are key issues. Energy spectra of a self extracted Au(-) beam from the source were measured under the condition of a constant work function of the production surface. The full width of half maximum (FWHM) increases from 3 to 9 eV monotonically as the target voltage increases from 50 V to 300 V, independently from the target surface work function of $2.2 - 3$ eV. DOE

N92-30091# National Inst. for Fusion Science, Nagoya (Japan).
FORMATION OF PRESHEATH AND CURRENT-FREE DOUBLE LAYER IN A TWO-ELECTRON-TEMPERATURE PLASMA

KUNIHITO SATO (Himeji Inst. of Tech., Japan) and FUJIO MIYAWAKI (Himeji Inst. of Tech., Japan) Feb. 1992 36 p
Submitted for publication
(ISSN 0915-633X)

(NIFS-132) Avail: CASI HC A03/MF A01

Development of the steady-state potential in a two-temperature-electron plasma in contact with the wall is investigated analytically. It is shown that if the hot- to cold electron temperature ratio is greater than ten, the potential drop in the presheath, which is allowed to have either a small value characterized by the cold electrons or a large value by the hot electrons, discontinuously changes at a critical value for the hot- to total electron density ratio. It is also found that the monotonically decreasing potential structure which consists of the first presheath, a current-free double layer, the second presheath, and the sheath can be steadily formed in a lower range of the hot- to total electron density ratio around the critical value. The current-free double layer is set up due to existence of the two electron species and cold ions generated by ionization so as to connect two presheath potentials at different levels. Author

N92-30172# National Inst. for Fusion Science, Nagoya (Japan).
HEAT FLOW OF A TWO-ELECTRON-TEMPERATURE PLASMA THROUGH THE SHEATH IN THE PRESENCE OF ELECTRON EMISSION

KUNIHITO SATO (Himeji Inst. of Tech., Japan) and FUJIO MIYAWAKI (Himeji Inst. of Tech., Japan) Mar. 1992 17 p
Submitted for publication
(ISSN 0915-633X)

(NIFS-136) Avail: CASI HC A03/MF A01

The electrostatic sheath and the heat flow of a two-electron-temperature plasma in the presence of electron emission is investigated analytically. It is shown that the energy flux is remarkably enhanced up to a value near the electron free-flow energy flux as a result of considerable reduction of the sheath potential due to electron emission if the fraction of hot electrons at the sheath edge is much smaller than one. If the hot- to cold-electron temperature is of the order of ten and the

hot electron density is comparable with the cold electron density, the action of the sheath as a thermal insulator is improved as a result of suppression of electron emission due to the space-charge effect of hot electrons. Author

N92-30384# National Inst. for Fusion Science, Nagoya (Japan). **MAGNETIC SURFACE BREAKING IN 3D MHD EQUILIBRIA OF $L = 2$ HELIOTRON** TAKAYA HAYASHI, AKIRA TAKEI, and TETSUYA SATO Jan. 1992 31 p Submitted for publication (ISSN 0915-633X) (NIFS-130) Avail: CASI HC A03/MF A01

Magnetic surface breaking due to the finite pressure effect is analyzed for 3-D magnetohydrodynamic equilibria of $L = 2$ Heliotron configuration. Characteristics of magnetic island formation are extensively surveyed. It is found that the well-hill criterion which was predicted by the local analysis is not always applicable for all cases. Author

N92-30385# National Inst. for Fusion Science, Nagoya (Japan). **FIELD LINE DIVERSION PROPERTIES OF FINITE BETA HELIAS EQUILIBRIA** T. HAYASHI, U. SCHWENN (Max-Planck-Inst. fuer Plasmaphysik, Munich, Germany, F.R.), and E. STRUMBERGER (Max-Planck-Inst. fuer Plasmaphysik, Munich, Germany, F.R.) Mar. 1992 16 p Submitted for publication Original contains color illustrations (ISSN 0915-633X) (NIFS-137) Avail: CASI HC A03/MF A01

The diversion properties of the magnetic field outside the last closed magnetic surface of the Helias stellarator configuration are investigated for the finite beta-equilibrium. The results support a divertor concept which has been developed from the diversion properties of the corresponding vacuum field. Cross-field transport is simulated by a simplified scrape-off layer (SOL) model. Author

N92-30430# National Inst. for Fusion Science, Nagoya (Japan). **TRITIUM CONTENT OF A DT PELLET IN INERTIAL CONFINEMENT FUSION** S. KAWATA (Nagaoka Technological Univ., Japan) and H. NAKASHIMA (Kyushu Univ., Fukuoka, Japan) Oct. 1991 17 p Sponsored in part by the Scientific Research Fund of the Ministry of Education and Culture in Japan (ISSN 0915-633X) (NIFS-113) Avail: CASI HC A03/MF A01

A numerical and an analytical estimations, and a one-dimensional hydrodynamic simulation present that the 30 percent order of reduction of the tritium content in a DT pellet can bring the sufficient energy output in a deuterium-tritium (DT) inertial confinement fusion reactor. In other words, the tritium content can be reduced significantly without a significant reduction in the DT fusion energy output. This new result also means that the tritium inventory can be reduced significantly before and during the reactor operation of a DD reaction to the DT reaction. Author

N92-30431# National Inst. for Fusion Science, Nagoya (Japan). **RECOMBINING PROCESSES IN A COOLING PLASMA BY MIXING OF INITIALLY HEATED GAS** UTARO FURUKANE (Ehime Univ., Matsuyama, Japan), KUNINORI SATO, KEN TAKIYAMA (Hiroshima Univ., Japan), and TOSHIATSU ODA (Hiroshima Univ., Japan) Mar. 1992 34 p Submitted for publication (ISSN 0915-633X) (NIFS-142) Avail: CASI HC A03/MF A01

A numerical investigation of recombining process in a high temperature plasma in a quasi-steady state is made in a gas contact cooling, in which the initial temperature effect of contact gas heated up by the hot plasma is considered as well as the gas cooling due to the surrounding neutral particles freely coming into the plasma. The calculation has shown that the electron temperature relaxes in accord with experimental results and that the occurrence of recombining region and the inverted populations almost agree with the experimental ones. Author

N92-30497# National Inst. for Fusion Science, Nagoya (Japan). **DYNAMIC ANALYSIS OF COMPACT HELICAL SYSTEM POWER SUPPLY AND DESIGNS OF ITS UPGRADE** S. TANAHASHI and S. YAMADA Sep. 1991 24 p (ISSN 0915-6356) (NIFS-TECH-2) Avail: CASI HC A03/MF A01

Computed dynamic waveforms are compared with measured ones for the power supply of the Compact Helical System (CHS) during 1.5T operation and found to be in good agreement. On the basis of these results, designs for the upgraded power supply for 2T operation are discussed in two cases - with and without power consumption for additional heating. In the former case, the additional heating power is supplied from the AC generator that powers the CHS coils. Electric voltages and currents in the electric circuit are shown for both cases. These designs show the possibility for 2T operation by the addition of some components without changing the ratings of existing components. Author

N92-30499# National Inst. for Fusion Science, Nagoya (Japan). **PLASMA PARAMETER ESTIMATIONS FOR THE LARGE HELICAL DEVICE BASED ON THE GYRO-REDUCED BOHM SCALING** MASAO OKAMOTO, NORIYSHI NAKAJIMA, and HIDEO SUGAMA Oct. 1991 25 p Sponsored in part by Ministry of Education, Science and Culture (ISSN 0915-633X) (NIFS-114) Avail: CASI HC A03/MF A01

A model of a gyro-reduced Bohm scaling law is incorporated into a 1-D transport code to predict plasma parameters for the Large Helical Device (LHD). The transport code calculations reproduce well the LDH empirical scaling law and basic parameters and profiles of the LHD plasma are calculated. The amounts of toroidal currents (bootstrap current and beam-driven current) are also estimated. Author

N92-30984# National Inst. for Fusion Science, Nagoya (Japan). **X RAY RADIATION FROM HOT DENSE PLASMAS AND ATOMIC PROCESSES** Oct. 1991 188 p (ISSN 0915-6348) (NIFS-PROC-9) Avail: CASI HC A09/MF A02

Given here are papers from a conference on x-ray radiation from hot-dense plasmas and atomic processes. A statistical method to evaluate the opacity of hot, high-Z plasmas is considered by taking account of a line group stemming from the same transitions in different charge states. The structure of the line group is described and used to model effective line profiles in numerically treating radiation transport in fluid codes. Dispersion of line spread is obtained by a statistical method with the use of the averaged electron configuration of ions. The validity of the method is studied by reducing the Saha equilibrium relation in the local thermodynamic equilibrium limit. Other topics discussed include practical inertial confinement fusion and its numerical modeling, radiation transport dependence on modeling in laser-produced plasmas, atomic and radiative processes in tokamak plasmas, the thermal structure of astrophysical plasmas, and atomic physics and plasma simulation. Author

N92-30985# National Inst. for Fusion Science, Nagoya (Japan). **BETA LIMIT OF RESISTIVE PLASMA IN TORSATRON/HELIOTRON** K. ITOH, K. ICHIGUCHI, and SANAE-I. ITOH Feb. 1992 23 p Submitted for publication (ISSN 0915-633X) (NIFS-131) Avail: CASI HC A03/MF A01

Stability against the interchange mode in the Torsatron/Heliotron device is investigated, taking into account the effects of the resistivity, current diffusivity, ion viscosity, and thermal diffusivity. Critical beta for the low-mode-number stability is found at the finite beta value. For the range plasma parameters of the present experiments, the resistive mode and current diffusive mode set comparable critical beta values, which are consistent with

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experimental observations. In future high temperature plasmas, the current diffusive mode determines the stability limit for the global mode. Author

N92-30991# National Inst. for Fusion Science, Nagoya (Japan).
A STEADY STATE TOKAMAK OPERATION BY USE OF MAGNETIC MONOPOLES

K. NARIHARA Dec. 1991 27 p
 (ISSN 0915-633X)

(DE92-799109; NIFS-126) Avail: CASI HC A03/MF A01

A steady state tokamak operation based on a magnetic monopole generates the needed loop voltage. The monopole circuit is enclosed by a series of solenoid coils in which the magnetic field is feedback controlled so that the force on the circuit balance against the mechanical friction. The driving power is supplied through the current sources of poloidal, ohmic, and solenoid coils. The current drive efficiency is same as that of the ohmic current drive. Author

N92-30992# National Inst. for Fusion Science, Nagoya (Japan).
EDGE POLOIDAL ROTATION PROFILES OF H-MODE PLASMAS IN THE JFT-2M TOKAMAK

K. IDA, S. HIDEKUMA, M. KOJIMA, Y. MIURA (Japan Atomic Energy Research Inst., Naka.), S. TSUJI (Japan Atomic Energy Research Inst., Naka.), K. HOSHINO (Japan Atomic Energy Research Inst., Naka.), M. MORI (Japan Atomic Energy Research Inst., Naka.), N. SUZUKI (Japan Atomic Energy Research Inst., Naka.), T. YAMAUCHI (Japan Atomic Energy Research Inst., Naka.) et al. Dec. 1991 37 p
 (ISSN 0915-633X)

(DE92-799107; NIFS-124) Avail: CASI HC A03/MF A01

Parameter dependence of the radial structure of the edge poloidal rotation is studied with spectroscopic measurements for L- and H-mode plasmas in the JFT-2M tokamak. The peak of poloidal flow in the electron diamagnetic direction suddenly appears near the plasma edge in H-mode. No critical normalized ion collisionality for the transition of L- to H-mode is observed. The size of the poloidal flow in H-mode has no dependence on poloidal gyro-radius. Author

N92-30993# National Inst. for Fusion Science, Nagoya (Japan).
KINETIC APPROACH TO LONG WAVE LENGTH MODES IN ROTATING PLASMAS

T. YAMAGISHI (Fukui Inst. of Tech., Japan) Mar. 1992 31 p
 Submitted for publication
 (ISSN 0915-633X)

(NIFS-138) Avail: CASI HC A03/MF A01

Stability of low frequency long wave length modes is studied by a kinetic approach in rotating Maxwellian plasmas. In the rigid rotator model, the centrifugal force due to the plasma rotation strongly destabilizes the ballooning modes particularly when the Mach number is close to unity. The fluid flow shear weakly stabilizes the ballooning mode. Energetic particles are effective to stabilize the ballooning mode particularly in the high-Beta region even in the rotating plasmas. The electric potential induced from the radial electric field increases the particle trapping rate for $e(\Phi)$ greater than 0. For Φ less than 0 as in tokamaks, electron trapping rate increases, which destabilizes the dissipative trapped electron mode. Author

N92-30994# National Inst. for Fusion Science, Nagoya (Japan).
THREE-DIMENSIONAL MHD EQUILIBRIUM IN THE PRESENCE OF BOOTSTRAP CURRENT FOR LARGE HELICAL DEVICE (LHD)

K. WATANABE (Kyoto Univ., Japan), N. NAKAJIMA, M. OKAMOTO, Y. NAKAMURA, and M. WAKATANI (Kyoto Univ., Japan) Mar. 1992 44 p
 Submitted for publication
 (ISSN 0915-633X)

(NIFS-139) Avail: CASI HC A03/MF A01

Three-dimensional MHD equilibria including the bootstrap current self-consistently are studied for the Large Helical Device (LHD). Magnitude of the bootstrap current is sensitive to the magnetic axis position or Shafranov shift in LHD, which is

proportional to the plasma pressure and inversely proportional to the rotational transform. Since the bootstrap current enhances the rotational transform and reduces Shafranov shift, the self-consistent MHD equilibrium is crucial to estimate the bootstrap current. Total bootstrap current easily exceeds 100 kA for LHD plasmas with (beta) approx. greater than 1 percent under the assumption that both electrons and ions belong to the rare-collisional $1/\epsilon$ regime in the whole plasma region, where (Beta) is a volume averaged beta value. Effects of the vertical field, the quadrupole field and the pressure profile on the bootstrap current are also investigated. Author

N92-30995# National Inst. for Fusion Science, Nagoya (Japan).
NEW METHOD OF ERROR ELIMINATION IN POTENTIAL PROFILE MEASUREMENT OF TOKAMAK PLASMAS BY HIGH VOLTAGE HEAVY ION BEAM PROBES

Y. HAMADA, K. MASAI, Y. KAWASUMI, H. IGUCHI, and A. FUJISAWA Apr. 1992 33 p
 Submitted for publication
 (ISSN 0915-633X)

(NIFS-143; AD-B166249L) Avail: CASI HC A03/MF A01

The measurement of a potential profile in tokamak plasmas by heavy ion beam probe (HIBP) in a single shot is usually difficult, because as primary beam is swept through plasma cross-section, the secondary beam hits the input slit of an energy analyzer with a large variation in entrance angles (in-plane and out-of-plane). In this paper, a new method (the application of fast toroidal sweeps of the primary or the secondary beam at the analyzer or at an entrance to a tokamak) is proposed to eliminate the error due to the change in the entrance angle. In addition, results of a new calibration method of HIBP in tokamaks (electron stripping by neutral gas) are presented. Author

N92-31659# National Inst. for Fusion Science, Nagoya (Japan).
THEORY OF ANOMALOUS TRANSPORT IN TOROIDAL HELICAL PLASMAS

K. ITOH, SANAE-I. ITOH, and A. FUKUYAMA (Okayama Univ., Japan) Mar. 1992 19 p
 Submitted for publication
 (ISSN 0915-633X)

(NIFS-140) Avail: CASI HC A03/MF A01

A theoretical model of the anomalous transport in Torsatron/Heliatron plasmas is developed, based on the current-diffusive interchange instability which is destabilized due to the averaged magnetic hill near edge. An analytic formula of a transport coefficient is derived. This model explains the high edge transport, the power degradation and energy confinement scaling law, and the enhanced heat pulse thermal conduction. Author

N92-31843# National Inst. for Fusion Science, Nagoya (Japan).
SIMULATION STUDY OF STEPWISE RELAXATION IN A SPHEROMAK PLASMA

RITOKU HORIUCHI, MASAYA UCHIDA, and TETSUYA SATO Oct. 1991 44 p

(DE92-782101; NIFS-111) Avail: CASI HC A03/MF A01

The energy relaxation process of a spheromak plasma in a flux conserver is investigated by means of a three-dimensional magnetohydrodynamic simulation. The resistive decay of an initial force-free profile brings the spheromak plasma to an $m = 1/n = 2$ ideal kink unstable region. It is found that the energy relaxation takes place in two steps; namely, the relaxation consists of two physically distinguished phases, and there exists an intermediate phase in between, during which the relaxation becomes inactive temporarily. The first relaxation corresponds to the transition from an axially symmetric force-free state to a helically symmetric one with an $n = 2$ crescent magnetic island structure via the helical kink instability. The $n = 2$ helical structure is nonlinearly sustained in the intermediate phase. The helical twisting of the flux tube creates a reconnection current in the vicinity of the geometrical axis. The second relaxation is triggered by the rapid growth of the $n = 1$ mode when the reconnection current exceeds a critical value. The helical twisting relaxes through magnetic reconnection toward an axially symmetric force-free state. It is also found that the poloidal flux reduces during the helical twisting in the first

relaxation and the generation of the toroidal flux occurs through the magnetic reconnection process in the second relaxation.

DOE

N92-32181# National Inst. for Fusion Science, Nagoya (Japan).
ENERGY TRANSPORT IN THE STEADY STATE PLASMA SUSTAINED BY DC HELICITY CURRENT DRIVE

K. ITOH, S.-I. ITOH, and A. FUKUYAMA (Okayama Univ., Japan) Jan. 1992 17 p Submitted for publication
 (ISSN 0915-633X)

(NIFS-127) Avail: CASI HC A03/MF A01

The steady state operation of tokamaks which is sustained by the DC helicity current drive near edge is obtained. We studied the steady state toroidal plasma where the toroidal current is generated near the edge and transferred to the core region by the cross field transport of the plasma current. If the current diffusivity is high, such a scheme for DC helicity current drive allows enough plasma current at the axis. However, the quantitative estimate of the required value for the current diffusivity shows that the energy transport coefficient must also be high, so that the actual application to high temperature plasmas would be difficult. This indicates the importance of the method for transporting the current. The radio frequency (rf) helicity current drive was shown to work.

Author

N92-32552# National Inst. for Fusion Science, Nagoya (Japan).
TWO- AND THREE-DIMENSIONAL SIMULATION CODE FOR RADIATION-HYDRODYNAMICS IN ICF

T. YABE (Gunma Univ., Japan) and T. ISHIKAWA (Gunma Univ., Japan) Nov. 1991 29 p Submitted for publication
 (ISSN 0915-633X)

(NIFS-119) Avail: CASI HC A03/MF A01

A multi-dimensional radiation hydrodynamic code is developed and is applied to the interaction of an intense ion beam with plasmas. The hydrocode is based on a newly developed, highly-accurate scheme, Cubic-Interpolated Pseudoparticle (CIP). The radiation transport is solved with the Symmetrical Semi-Implicit (SSI) scheme, which is quite easily implemented and is 4-5 times faster than the incomplete Cholesky conjugate gradient algorithm (ICCG). The Thomas-Fermi equation of state (EOS) is used for the atomic data and the Tsakiris and Eidmann formula for the Rosseland mean-free path. This newly developed two-dimensional code is used to design an extraction method of the radiation from the high temperature region heated by ion beam. The ion beam of 3 TW/cm(exp 2) is converted into the soft X-ray of 40 TW/cm(exp 2) at the surface of the radiation emitter.

Author

N92-32745# National Inst. for Fusion Science, Nagoya (Japan).
FAST ION LOSS AND RADIAL ELECTRIC FIELD IN WENDELSTEIN 7-A STELLARATOR

K. ITOH, H. SANUKI, and S. ITOH Oct. 1991 46 p
 (DE92-782106; NIFS-117) Avail: CASI HC A03/MF A01

A theoretical model is developed to determine the radial electric field and the fast ion loss simultaneously in stellarators, and is applied to the Wendelstein 7-A stellarator. The predicted value of the radial electric field is more closer to experiments than the purely neoclassical calculation. The loss rate, which is determined simultaneously, is in the range of experimental observations. The partition of the injection energy by the bulk heating, direct orbit loss, and shine through is estimated by using the self consistent electric field profile. The orbit loss becomes noticeable as the injection energy increases. The influence of the neutral particles is also studied. Neutral particles enhances the negative radial electric field, and reduces the direct orbit loss by the expense of the charge exchange loss. The impact of the increased radial electric field on the neoclassical ion thermal energy loss is compared to the direct loss of fast ions. The reduction of the neoclassical loss is much smaller than the orbit loss.

DOE

N92-33388# National Inst. for Fusion Science, Nagoya (Japan).
HELICAL DIVERTOR IN THE LARGE HELICAL DEVICE

N. OHYABU, N. NODA, HANTAO JI, H. AKAO (Nippon Electric Co. Ltd., Tokyo, Japan), K. AKASHI, T. ONO (Nagoya Univ.,

Japan), H. KANEKO, T. KAWAMURA, Y. KUBOTA, S. MORIMOTO et al. May 1992 21 p Submitted for publication
 (ISSN 0915-633X)

(NIFS-144; AD-B166252L) Avail: CASI HC A03/MF A01

The Large Helical Device (LHD), presently under construction, is a Heliotron/torsatron device with a closed divertor system. The edge LHD magnetic structure was studied in detail. A peculiar feature of the configuration is the existence of edge surface layers, a complicated three dimensional magnetic structure. However it does not seem to hamper the expected divertor functions. As a confinement improvement scheme for the LHD, we have proposed a high temperature divertor plasma operation in which a divertor plasma with a temperature of a few keV, generated by efficient pumping, leads to the confinement improvement. Conceptual designs of the LHD divertor components are under way.

Author

N92-33389# National Inst. for Fusion Science, Nagoya (Japan).
EDGE PLASMA DENSITY RECONSTRUCTION FOR FAST MONOENERGETIC LITHIUM BEAM PROBING

S. SASAKI (Nagoya Univ., Japan), S. TAKAMURA (Nagoya Univ., Japan), M. UEDA, H. IGUCHI, J. FUJITA, and K. KADOTA (Nagoya Univ., Japan) May 1992 24 p Submitted for publication
 (ISSN 0915-633X)

(NIFS-147; AD-B166255L) Avail: CASI HC A03/MF A01

Two types of plasma density reconstruction methods for fast Li(sup 0) beam probe diagnostics were developed for edge profile measurements in the Compact Helical System device. In these methods, the density dependence of atomic processes such as ionization, excitation/deexcitation, and charge exchange is introduced by the use of effective rate coefficients that are calculated from the collisional radiative model. These methods enable us to get a plasma density profile well inside the last closed flux surface (LCFS) for a range of plasma densities, while considering attenuation of the fast Li(sup 0) beam and using effective rate coefficients. A new method (method-1) can unfold the plasma density profiles from a fractional part of the emission profile of the Li 1 resonance line. The second method (method-2) reconstructs the density profile from the whole range of emission profiles, including the signal tail-off region due to the beam attenuation. These two methods, which introduce the density dependence of atomic processes and the beam attenuation caused by ionization, noticeably improve the precision of the measurements and extend the measurements and extend the applicable density region of the plasma. Density profiles reconstructed by these two different methods have shown good agreement and are consistent with results from ruby laser Thomson scattering.

Author

N92-33406# National Inst. for Fusion Science, Nagoya (Japan).
A MODEL OF MAJOR DISRUPTION IN TOKAMAKS

KIMITAKA ITOH, SANAE-I. ITOH, ATSUSHI FUKUYAMA (Okayama Univ., Japan), SHUNJI TSUJI (Japan Atomic Energy Research Inst., Ibaraki.), and ALLAN J. LICHTENBERG (California Univ., Berkeley.) May 1992 21 p Submitted for publication
 (ISSN 0915-633X)

(NIFS-146; AD-B166250L) Avail: CASI HC A03/MF A01

A mechanism for detecting the onset of the major disruption is proposed. The mechanism considers the effect of magnetic stochasticity on the growth of the m = 2 tearing mode. The toroidicity can cause stochasticity near the separatrix of the m = 2 magnetic island. This enhances the current viscosity and results in explosive growth. The threshold condition and the time scale of rapid growth are studied. Also, the role of the toroidal coupling to the m = 1 component is discussed.

Author

N92-33408# National Inst. for Fusion Science, Nagoya (Japan).
HIGH-ETA HELICITY-INDUCED SHEAR ALFVEN EIGENMODES

N. NAKAJIMA, C. Z. CHENG, and M. OKAMOTO May 1992 28 p Submitted for publication
 (Contract DE-AC02-76CH-03073) (ISSN 0915-633X)

(NIFS-148; AD-B166254L) Avail: CASI HC A03/MF A01

The high-eta Helicity-induced shear Alfvén Eigenmodes (HAE) are considered both analytically and numerically for a straight helical magnetic system, where eta is the toroidal mode number. The

eigenmode equation for the high-eta HAE modes is derived along the field line and with the aid of the averaging method is shown to reduce to the Mathieu equation asymptotically. The discrete HAE modes are shown to exist inside the continuum spectrum gaps. The continuous spectrum gaps appear around $\omega(\exp 2) = \omega(\text{sub } A)(\exp 2)(N(L(\text{sub } \tau) - m)/2)(\exp 2)$ for $N = 1, 2, \dots$, where $\omega(\text{sub } A)$ is the toroidal Alfvén transit frequency, and l , m , and τ are the polarity of helical coils, the toroidal pitch number of helical coils, and the rotational transform, respectively. For the same $\omega(\text{sub } A)$ and τ , the frequency of the helical continuum gap is larger than that of the continuum gap in tokamak plasmas by the absolute value of $l - \tau(\exp -1)(m)$. The polarity of helical coils l plays a crucial role in determining the spectrum gaps and the properties of the high-eta HAE modes. The spectrum gaps near the magnetic axis are created by the helical ripple with circular flux surfaces for $l = 1$, and greater than or equal to 3 helicals. For $l = 2$ helical systems, the spectrum gaps are created by the ellipticity of the flux surfaces. These analytical results for the continuum gaps are created by the existence of the high-eta HAE modes in the continuum gaps are confirmed numerically for the $l = 2$ case, and we find that the HAE modes exist for mode structures with the even and the odd parties. Author

N92-33628# National Inst. for Fusion Science, Nagoya (Japan). **COUPLING TO THE LOWER HYBRID WAVES WITH THE MULTIJUNCTION GRILL** KUNIZO OHKUBO and KAZUNORI MATSUMOTO (Toyama Prefectural Univ., Imizugun, Japan) May 1992 37 p Submitted for publication (ISSN 0915-633X) (NIFS-145) Avail: CASI HC A03/MF A01

Coupling characteristics of the multijunction grill were studied theoretically and experimentally by using a multireflection method with the aid of scattering matrices not only at the junction plane but also at the grill mouth. The global reflection coefficients in the primary waveguide and secondary waveguides can be estimated from the vector sum of reflecting components caused by each reflection between two scattering planes. The experimental results of scattering matrices and the global coupling agree well with calculated ones. It is shown that the multiple reflection in secondary waveguides of the four-junction grill for JIPPT-IIU tokamak is finished until three or four reflections. The length of the secondary waveguides is confirmed to be one of the parameters determining the grill efficiency. Author

N92-33743# National Inst. for Fusion Science, Nagoya (Japan). **SHAFRANOV SHIFT IN LOW-ASPECT-RATIO HELIOTRON/TORSATRON CHS** H. YAMADA, K. IDA, H. IGUCHI, K. HANATANI (Kyoto Univ., Uji, Japan), S. MORITA, O. KANEKO, H. C. HOWE (Oak Ridge National Lab., TN.), S. P. HIRSHMAN (Oak Ridge National Lab., TN.), D. K. LEE (Oak Ridge National Lab., TN.), H. ARIMOTO et al. Sep. 1991 31 p (ISSN 0915-633X) (NIFS-110) Avail: CASI HC A03/MF A01

The MHD equilibrium properties of neutral-beam-heated plasmas have been experimentally investigated in the Compact Helical System (CHS), a low-aspect-ratio ($A(\text{sub } p)$ about 5) heliotron/torsatron. This configuration is characterized by a strong breaking of helical symmetry. The radial profiles measured by various diagnostics have shown significant Shafranov shift due to plasma pressure. The deviation of the magnetic axis from its vacuum position has reached 50 percent of the minor radius. When the three-dimensional equilibrium code VMEC is used to reconstruct the equilibrium from the experimental data, the result is in good agreement with the experimentally observed Shafranov shift as well as the diamagnetic pressure in plasmas with (β) less than or equal to 1.2 percent and $\beta(\text{sub } 0)$ less or equal to 3.3 percent. This β value corresponds to half of the conventional equilibrium β limit defined by the Shafranov shift reaching a value of half of the minor radius. Although tangential neutral beam injection has caused pressure anisotropies $p(\text{sub } \text{parallel})/p(\text{sub } \text{perpendicular})$ less than or equal to 3, the description of the equilibrium assuming isotropic pressure is consistent with the experiment. Author

perpendicular) less than or equal to 3, the description of the equilibrium assuming isotropic pressure is consistent with the experiment. Author

N92-33867# National Inst. for Fusion Science, Nagoya (Japan). **INTERNAL STRUCTURES OF SELF-ORGANIZED RELAXED STATES AND SELF-SIMILAR DECAY PHASE** Y. KONDOH (Gunma Univ., Japan) Mar. 1992 43 p Submitted for publication (ISSN 0915-633X) (NIFS-141) Avail: CASI HC A03/MF A01

A thought analysis on relaxation due to nonlinear processes is presented to lead to a set of general thoughts applicable to general nonlinear dynamical systems for finding out internal structures of the self-organized relaxed state without using 'invariant'. Three applications of the set of general thoughts to energy relaxations in resistive MHD plasmas, incompressible viscous fluids, and incompressible viscous MHD fluids are shown to lead to the internal structures of the self-organized relaxed states. It is shown that all of the relaxed states in these three dynamical systems are followed by self-similar decay phase without significant change of the spatial structure. The well known relaxed state of $\text{DeI times } B = \text{plus or minus } \lambda B$ is shown to be derived generally in the low beta plasma limit. Author

N92-34235# National Inst. for Fusion Science, Nagoya (Japan). **FLUCTUATION AND EDGE CURRENT SUSTAINMENT IN A REVERSED-FIELD-PINCH** H. JI (Tokyo Univ., Japan), H. TOYAMA (Tokyo Univ., Japan), A. FUJISAWA (Tokyo Univ., Japan), S. SHINOHARA (Tokyo Univ., Japan), and K. MIYAMOTO (Tokyo Univ., Japan) Feb. 1991 19 p Submitted for publication (ISSN 0915-633X) (NIFS-135) Avail: CASI HC A03/MF A01

Simple Ohm's law $\text{eta}(\text{sub } \text{parallel}) = E(\text{sub } \text{parallel})$ is not satisfied in an $a/2$ less than or approximately $= r$ less than or $=$ a region of the REPUTE-1 RFP plasma. Fluctuation-induced electric fields, such as $(v(\text{tilde}) \times B(\text{tilde}))$, are not sufficient to account for $\text{eta}(\text{sub } \text{parallel}) - E(\text{sub } \text{parallel})$ at the edge. It is implied that current-diffusions due to magnetic fluctuations, carried by fast electrons rather than bulk cold electrons, sustain the edge parallel equilibrium current. Author

N92-70220 National Inst. for Fusion Science, Nagoya (Japan). **A 3-DIMENSIONAL SIMULATION OF DYNAMO EFFECT OF REVERSED FIELD PINCH** SHINJI KOIDE Sep. 1990 30 p (DE91-790863; NIFS-50) Avail: CASI HC A03/MF A01

A nonlinear numerical simulation of the dynamo effect of a reversed field pinch (RFP) with finite beta is presented. It is shown that the $m=-1$, $n=(9,10,11,\dots,19)$ modes cause the dynamo effect and sustain the field reversed configuration. The role of the $m=0$ modes on the dynamo effect is carefully examined. Our simulation shows that the magnetic field fluctuation level scales as $S(\exp -0.2)$ or $S(\exp -0.3)$ in the range of S between $10(\exp 3)$ and $10(\exp 5)$, while Nebel, Caramana, and Schnack obtained the fluctuation level is independent of S for a pressureless RFP plasma. DOE

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SOLID-STATE PHYSICS

Includes superconductivity.

A92-10051 **SURFACE ANALYSIS OF C-AXIS-ORIENTED YBA2CU3O(7-X) THIN FILMS BY QMS, XPS AND LEED - EFFECTS OF IN-VACUUM ANNEALING** SO TANAKA, TAKAO NAKAMURA, MICHITOMO IYAMA

(Sumitomo Electric Industries, Ltd., Information and Electronic Laboratories, Osaka, Japan), NORIYUKI YOSHIDA, and SATORU TAKANO (Sumitomo Electric Industries, Ltd., Osaka Laboratories, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1458-L1461. refs
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A92-10052

ANISOTROPY IN THE MAGNETIC PENETRATION DEPTH OF (103)YBa₂Cu₃O_{7-x} THIN FILMS

SATOSHI KOHJIRO, TETSUYA TACHINO, HIROSHI AKOH, and SUSUMU TAKADA (Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1471-L1473. refs
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The resonator technique in transmission lines is employed to study the anisotropy in the magnetic penetration depth at 4.2 K in the films. The (103)-oriented YBa₂Cu₃O_{7-x} (YBCO) films are employed so that the magnetic penetration depths can be measured for both current flow across and parallel to the Cu-O planes. The observed anisotropy in the magnetic penetration depth is consistent with the anisotropic resistivity of (103)YBCO films. C.C.S.

A92-10053

SUPERCONDUCTING YBa₂Cu₃O_x THIN FILM GROWTH ON A VICINAL SURFACE OF NDGAO₃ SUBSTRATE

MASASHI MUKAIDA, SHINTARO MIYAZAWA, and MASAHIRO SASAURA (NTT, LSI Laboratories, Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1474-L1476. refs
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Surface morphology is observed for a superconducting YBa₂Cu₃O_x (YBCO) thin film grown on a 1.7-deg off angle vicinal surface of lattice-matched NdGaO₃ Substrate. Ragged steplike edges are clearly observable with exclusions in the front of the edges. The height of a step is measured to be 20-30 Å and is calculated from the vicinal angle and the terrace width to be 23 + or - 2 Å, indicating an evidence for a doubled periodicity of YBCO crystal c-axis unit length of about 12 Å. Author

A92-10054

INFLUENCE OF OZONE CONCENTRATION ON THE PREPARATION OF STOICHIOMETRIC SUPERCONDUCTING Y-Ba-Cu-O FILMS BY A METALORGANIC CHEMICAL VAPOR DEPOSITION TECHNIQUE

HIROSHI OHNISHI, YOSHIYUKI GOTO (Mitsubishi Electric Corp., Manufacturing Development Laboratory, Amagasaki, Japan), HIROSHI HARIMA, and KUNIHIDE TACHIBANA (Kyoto Institute of Technology, Matsugasaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1477-L1479. refs
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As-grown, nearly stoichiometric YBa₂Cu₃O_{7-x} superconducting films were prepared by a metalorganic chemical vapor deposition technique on SrTiO₃ (100) substrates at 650 C. This letter describes how the film characteristics change with the concentration of ozone in O₂ gas. It was found that the superconducting characters of nearly stoichiometric films can be improved by optimizing the ozone concentration. At 3 percent concentration of ozone, a film with the zero-resistive temperature of 85 K was obtained at a composition of Y:Ba:Cu = 1.1:2:2.7. It had a smooth surface morphology and a good c-axis orientation. Author

A92-10055

EPITAXIAL GROWTH OF Ba(1-x)K(x)BiO₃ THIN FILMS BY HIGH-PRESSURE REACTIVE RF-MAGNETRON SPUTTERING

KAZUHIKO TAKAHASHI, MASAHIRO IYORI, MARUO KAMINO, TATSURO USUKI, YORINOBU YOSHISATO, and SHOICHI NAKANO (Sanyo Electric Co., Ltd., Functional Materials Research Center, Hirakata, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Aug. 15, 1991, p. L1480-L1482.

Research sponsored by New Energy and Industrial Technology Development Organization. refs
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Epitaxial growth of Ba(1-x)K(x)BiO₃ (110) thin films has been carried out on SrTiO₃ (110) substrates using reactive RF magnetron sputtering for the first time under an 80-Pa discharge gas at a higher pressure than usual. Electrical measurements showed that T_c of as-grown films was 16 K. A preferred orientation of (110) and epitaxial growth of the Ba-K-Bi-O film on the substrates were confirmed by XRD and RHEED. Author

A92-10088

FILM STRUCTURE AND MAGNETIC PROPERTIES OF FERROMAGNETIC AMORPHOUS Bi₂O₃-Fe₂O₃-PbTiO₃ FILMS PREPARED BY RF-REACTIVE SPUTTERING

A. KAJIMA (Kitakyushu College of Technology, Japan), T. KANEDA, H. ITO, T. FUJII (Toyoashi University of Technology, Japan), and I. OKAMOTO (Ube Industries, Ltd., Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Oct. 1, 1991, p. 3760-3764. refs
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Amorphous-like oxide films of the Bi₂O₃-Fe₂O₃-PbTiO₃ ternary system prepared by RF-reactive sputtering exhibit ferromagnetism and ferroelectricity simultaneously well above room temperature. In this paper, the relation between the film structure and the magnetic properties of the films is investigated by means of X-ray diffractometry, transmission electron microscopy, magnetization measurement with a vibrating-sample magnetometer, and Moessbauer spectroscopy. The film composition used in the study is 0.16Bi₂O₃-0.74Fe₂O₃-0.10PbTiO₃, which attains the maximum magnetization in this ternary system. It is revealed that ferromagnetism originates from the amorphous part in the films. Author

A92-10302

PREPARATION OF Y-Cu-O/BA-Cu-O MULTILAYERED THIN FILMS AND THERMAL DIFFUSION BEHAVIOR OF THE INTERFACE

TOSHIKI ASAKAWA, TADASHI SHIRAIISHI, SHINYA NAKANISHI, TOHRU HIRAYAMA, HIRONOBU SAKATA, MASATAKE AMANO (Tokai University, Hiratsuka, Japan), HIROTOSHI NAGATA, AKIHIKO TAKANO, TAKUYA HASHIMOTO, MAMORU YOSHIMOTO (Tokyo Institute of Technology, Yokohama, Japan) et al. Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Aug. 1991, p. 1676-1678. Research supported by MOESC. refs
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Thermal diffusion equations are examined to describe the thermal stability of the interface of a multilayered Y-Cu-O/Ba-Cu-O film prepared by plasma-controlled sputtering. Multilayered structures are observed at substrate temperatures no more than 300 C corresponding to deposition rates of 0.13 and 0.16 nm, and homogeneous compositions are noted for temperatures above 300 C. The experimentally derived critical temperature supports the value calculated from the diffusion equation related to the interface of a pair of semiinfinite solids. C.C.S.

A92-10389

SUPERCONDUCTIVITY OF Bi₂Sr₂Ca(n-1)Cu(n)O(y) (n = 2,3,4 AND 5) THIN FILMS PREPARED IN SITU BY MOLECULAR-BEAM EPITAXY TECHNIQUE

Y. NAKAYAMA, Y. TSUKADA, and K. UCHINOKURA (Tokyo, University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, Oct. 15, 1991, p. 4371-4377. Research supported by MOESC. refs
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Preparation techniques and properties of Bi-Sr-Ca-Cu-O thin films are reported. The optimization of the substrate temperature ozone atmosphere and the shuttering of molecular beams on an atomic scale permitted the preparation of thin films of Bi₂Sr₂Ca(n-1)Cu(n)O(y) (n = 1,2,3,4, and 5). These films showed superconducting transition with the exception of the n = 1 phase and resistivities showed strong temperature-dependence without

heat treatment after deposition. Reflection high-energy electron diffraction showed sharp streaks, which suggest the growth of films with flat surfaces on an atomic scale. Author

A92-11296**NONLINEAR I-V CHARACTERISTICS OF $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(x)$ THIN FILMS**

HIROAKI MYOREN, TAKATOSHI ISHIKAWA, and YUKIO OSAKA (Hiroshima University, Higashi-Hiroshima, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 1, 1991, p. L1553-L1555. refs

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The nonlinear I-V characteristics in magnetic fields of 100 nm-thick $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(x)$, films on $\text{MgO}(100)$ substrates were measured. In addition to the published results on $\text{YBa}_2\text{Cu}_3\text{O}(x)$ and $\text{Ti}_2\text{Ba}_2\text{CaCu}_2\text{O}(x)$, the present measurement suggests that nonlinear I-V characteristics of high- T_c superconductors are universal and in agreement with a theoretical prediction based on a 3D superconducting vortex-glass phase. Author

A92-11299**SHAPE OF THE GAINAS/INP MULTIQUANTUM WELL POTENTIAL OBSERVED BY SCANNING TUNNELING MICROSCOPY**

TAKASHI KATO and FUKUNOBU OSAKA (Optoelectronics Technology Research Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 1, 1991, p. L1586, L1587. refs

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A92-11846**IN-PLANE ANISOTROPIC TRANSPORT PROPERTIES OBSERVED IN EPITAXIAL $\text{Bi}_2(\text{Sr},\text{Ca})_3\text{Cu}_2\text{O}(x)$ FILMS GROWN ON TILTED $(001)\text{SrTiO}_3$ SUBSTRATE**

J. FUJITA, T. YOSHITAKE, T. SATOH, S. MIURA, H. TSUGE, and H. IGARASHI (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Nov. 4, 1991, p. 2445-2447. Research supported by New Energy Development Organization. refs

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A92-11848**STRONG ANISOTROPY OF THE RESISTIVE TRANSITION IN Bi-Sr-Ca-Cu-O THIN FILMS PREPARED BY METALORGANIC CHEMICAL VAPOR DEPOSITION**

SHIGENORI YUHYA, KOICHI NAKAO, TSUNEMI SUGIMOTO, DAVID J. BAAR, YUH SHIOHARA, and SHOUJI TANAKA (International Superconductivity Technology Center, Tokyo, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Nov. 4, 1991, p. 2451-2453. refs

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The resistivity of the Bi-Sr-Ca-Cu-O thin films deposited by MOCVD has been investigated. Samples of thickness from 5 to 300 nm have been studied. Zero resistance temperatures (T_c0) for all samples were about 70 K. For all samples, T_c0 was nearly independent of magnetic fields up to 6 tesla applied parallel to the film surface. In contrast, T_c0 decreased significantly in fields applied perpendicular to the film surface. This difference is suspected to originate in the nonpenetration of flux quanta (due to the large effective lower critical field for thin film in the parallel field case) and in the potential barrier to flux penetration at the surface of the thin films, in addition to the natural anisotropy of the Bi -based superconductors. Author

A92-11899**MECHANISM OF THE LORENTZ-FORCE-INDEPENDENT DISSIPATION IN $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(y)$**

YOICHI ANDO (International Superconductivity Technology Center, Central Research Institute of Electric Power Industry, Tokyo, Japan), NAOFUMI MOTOHIRA, KOICHI KITAZAWA (Tokyo, University, Japan), JUN-ICHI TAKEYA, and SHIRABE AKITA (Central Research Institute of Electric Power Industry, Tokyo,

Japan) Physical Review Letters (ISSN 0031-9007), vol. 67, Nov. 4, 1991, p. 2737-2740. refs

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A novel power law was found above 65 K in the I-V characteristics of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(y)$ single crystals with the magnetic field perpendicular to the c axis. At 80 K, the power-law exponent decreased sharply up to 1.5 T but remained nearly constant above it, suggesting an abrupt crossover to a different mechanism. An unusual field dependence of resistivity was also found, which cannot be explained by simple flux-flow theory. The above features of the Lorentz-force-independent dissipation can be consistently explained by a model based on 2D vortex-antivortex pair breaking. Author

A92-13106**FLUX PINNING AND PERCOLATION IN HIGH- T_C OXIDE SUPERCONDUCTORS**

TERUO MATSUSHITA, BAORONG NI, and KAORU YAMAFUJI (Kyushu University, Fukuoka, Japan) IN: Advances in cryogenic engineering - Materials. Vol. 36, pt. A. New York, Plenum Press, 1990, p. 403-412. refs

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Critical current characteristics in quench and melt growth (QMG) processed Y-Ba-Cu-O are investigated by ac inductive measurements. The critical current in these samples is percolative as is observed in sintered materials. However, this percolative behavior is not caused by weak-link grain boundaries but seems to be mainly attributed to layers of nonsuperconducting solidified melt. The experimental result of magnetization critical current density is compared with the theoretical estimate from the effective medium theory. It is also found that the shielding current with very high density flows locally inside the sample. Candidates for the dominant pinning centers in QMG processed samples are also discussed. Author

A92-13111**GROWTH AND SUPERCONDUCTING PROPERTIES OF $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-\Delta}$ THIN FILMS SPUTTERED ON FLEXIBLE YSZ SUBSTRATES**

SATOSHI TAKANO, NORIKI HAYASHI, SHIGERU OKUDA, HAJIME HITOTSUYANAGI (Sumitomo Electric Industries, Ltd., Osaka, Japan), KIYOSHI HASEGAWA, TAKUYA KISIDA, and JUN YAMAGUTI (Kansai Electric Power Co., Ltd., Osaka, Japan) IN: Advances in cryogenic engineering - Materials. Vol. 36, pt. A. New York, Plenum Press, 1990, p. 461-465. refs

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$\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-\Delta}$ thin films were grown on polycrystalline, flexible YSZ substrates by RF magnetron sputtering. A $T_c(R=0)$ of 90.3 K was obtained after annealing as the highest value. The films were composed of islands even at a film thickness of 2.4 microns, partially impinged on each other. J_c largely depended on the degree of island impingement. The effect of strain on the superconducting properties was investigated. $T_c(R=0)$ values raised as the compressive strain increased up to 0.3 percent, though they decreased as the tensile strain increased. J_c did not degrade under a compressive strain of 0.3 percent, though it degraded by 33 percent under a tensile strain of 0.3 percent. Author

A92-13116**EFFECTS OF BENDING STRAIN ON THE CRITICAL CURRENT DENSITY IN SUPERCONDUCTING $\text{YBa}_2\text{Cu}_3\text{O}(x)$ MULTICORE WIRES**

JITSUO CHIKABA (Kinki University, Iizuka, Japan) IN: Advances in cryogenic engineering - Materials. Vol. 36, pt. A. New York, Plenum Press, 1990, p. 549-555. refs

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Deterioration of the critical current density, J_c , as the result of bending strain is measured for silver-sheathed ceramic high- T_c superconducting wires. The multicore composite wires (3-85 cores) are fabricated by a conventional powder-in-tube method using $\text{YBa}_2\text{Cu}_3\text{O}(x)$ compound. Results concerning ceramic core diameters, thermal stress, and bending strain are discussed,

comparing the multicore wires with single core wires. The value of J_c in the multicore wires cannot reach a higher value than in the single core wire ($J_c = 1600 \text{ A/sq cm}$ in zero magnetic field) because of cracks and ruptures in the sheath which are attributed to unequal stress between cores. Multicore composite wires, however, have the advantage of suitable mechanical properties (especially flexibility due to good contact between the ceramic and the silver sheath). Author

A92-13118**STUDIES ON Bi-(Pb)-Sr-Ca-Cu-O SUPERCONDUCTING TAPES**

HISASHI SEKINE, KIYOSHI INOUE, HIROSHI MAEDA (National Research Institute for Metals, Tsukuba, Japan), and KOUICHI NUMATA (Mitsubishi Heavy Industries, Ltd., Advanced Technology Research Center, Yokohama, Japan) IN: *Advances in cryogenic engineering - Materials*. Vol. 36, pt. A. New York, Plenum Press, 1990, p. 593-602. refs

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Bi-(Pb)-Sr-Ca-Cu-O superconductor was fabricated into tapes without a sheath and into multifilamentary tapes with an Ag sheath. The specimens were prepared by a combination and repetition of cold pressing or cold rolling and a sintering. Measurements of magnetization and critical current density, J_c , in magnetic fields up to 23 T were made. The magnetization measurement revealed that, at 4.2 K, these tape specimens had excellent J_c -H characteristics while, at 77 K, the flux pinning force in the tape specimens was reduced to almost zero above 0.3 T due to thermal activation, i.e., flux creep. In the resistive J_c measurement at 4.2 K these tape specimens showed J_c of about $10,000 \text{ A/sq cm}$ at 18 T, and 7000 A/sq cm at 23 T. These results indicate that the Bi-(Pb)-Sr-Ca-Cu-O tapes could be used, for example, for the innermost coil of an extremely high-field superconducting magnet at 4.2 K in the near future. Author

A92-13169**HELICAL MICROTUBULES OF GRAPHITIC CARBON**

SUMIO IJIMA (NEC Corp., Tsukuba, Japan) *Nature* (ISSN 0028-0836), vol. 354, Nov. 7, 1991, p. 56-58. refs

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The preparation of a new type of finite carbon structure consisting of needlelike tubes is reported. Produced using an arc-discharge evaporation method similar to that used for fullerene synthesis, the needles grow at the negative end of the electrode used for the arc discharge. Electron microscopy reveals that each needle comprises coaxial tubes of graphitic sheets ranging in number from two up to about 50. On each tube the carbon-atom hexagons are arranged in a helical fashion about the needle axis. The helical pitch varies from needle to needle and from tube to tube within a single needle. It appears that this helical structure may aid the growth process. The formation of these needles, ranging from a few to a few tens of nanometers in diameter, suggests that engineering of carbon structures should be possible on scales considerably greater than those relevant to the fullerenes. C.D.

A92-13222**INFLUENCE OF THERMAL CYCLING ON CRITICAL CURRENT OF SUPERCONDUCTING SILVER-SHEATHED HIGH TC OXIDE WIRES**

S. OCHIAI, K. HAYASHI, and K. OSAMURA (Kyoto University, Japan) *Cryogenics* (ISSN 0011-2275), vol. 31, Nov. 1991, p. 954-961. refs

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The influence of thermal cycling between room temperature and 77 K on the critical current of silver-sheathed YBaCuO and Bi(Pb)SrCaCuO superconducting composite wires and tapes was studied. The critical current was reduced by cycling when the strength of the oxide was low but not when it was high. The experimental and calculated results on the stress exerted on the oxide suggested that the reduction resulted from the tensile stress

occurring on heating to room temperature, which caused fracture of the oxide when the oxide was weak. Author

A92-13453**POSITRON LIFETIME IN C60/C70 POWDER**

TOSHIYUKI AZUMA, HARUO SAITO, YASUNORI YAMAZAKI, KEN-ICHIRO KOMAKI, YASUYUKI NAGASHIMA, HIROSHI WATANABE, TOSHIO HYODO (Tokyo, University, Japan), HIROMICHI KATAURA, and NOBUO KOBAYASHI (Tokyo Metropolitan University, Hachioji, Japan) *Physical Society of Japan, Journal* (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2812-2814. refs

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The positron lifetime spectrum in C60/C70 powder was measured at room temperature. It is concluded that it has a single lifetime component 393 ps which implies that the positrons populate the ground state localized in the periodic free space of the C60/C70 crystal structure. O.G.

A92-13454**HELICAL STATES VS SOLITON AND VORTEX LATTICE STATES IN THE TWO-DIMENSIONAL HUBBARD MODEL**

MITUTAKA FUJITA, MASAHIKO ICHIMURA, and KENJI NAKAO (Tsukuba, University, Japan) *Physical Society of Japan, Journal* (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2831-2834. refs

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The spin and charge textures of the 2D Hubbard model are studied for a wide range of electron filling at the ground state both on a square lattice and on a triangular lattice within a mean field approximation. The overall phase diagram of the single-Q helical spin density wave state is completed which spreads widely in the electron filling and the Coulomb interaction plane is completed and the relative stability of the soliton and the vortex lattice states on it is discussed. It is shown that the imperfect nesting condition, which is the intrinsic feature of 2D systems, induces a rich variety of self-consistent solutions including collinear and noncollinear spin textures. Author

A92-13658**SOFT X-RAY EMISSION SPECTROSCOPY (SXES) STUDY OF THE VALENCE BAND ELECTRONIC STRUCTURE OF A AU-SI ALLOY**

HIROKUNI WATABE (Matsushita Electric Industrial Co., Ltd., Osaka, Japan), MOTOHIRO IWAMI, MASAHIKI HIRAI, MASAHIKO KUSAKA (Okayama University, Japan), and HATSUO NAKAMURA (Osaka Electro-Communications University, Neyagawa, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Sept. 1991, p. 1928-1930. Research supported by Toray Research Foundation. refs

(Contract MOESC-02232105)

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A92-13662**DIAGNOSIS OF SURFACE STABILITY OF 80K-PHASE BISrCaCuO SINGLE CRYSTALS WITH AND WITHOUT LI DOPING**

SATOSHI HIRATA, KEN SAKUTA, YASUFUMI FUJIWARA, and TAKESHI KOBAYASHI (Osaka University, Toyonaka, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 30, Sept. 1991, p. 1975, 1976. Research supported by MOESC, Kansai Electric Power Co., Inc., Sumitomo Electric Industries, Ltd., et al. refs

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The surface structure of 80 K-phase BiSrCaCuO single crystals with and without Li doping has been studied using low-energy electron diffraction at elevated temperatures. Although the superconducting critical temperature rises slightly with Li doping, the cleaved surface becomes amorphous in vacuum at temperature about 100 C lower than that of the undoped sample (600 C).

Author

A92-14177

POWER-LAW I-V CHARACTERISTICS IN THE SUPERCONDUCTING TRANSITION REGION OF BI-SR-CA-CU-O SINGLE CRYSTAL UNDER MAGNETIC FIELDS

YOICHI ANDO (ISTEC, Superconductivity Research Laboratory, Tokyo, Japan), NAOFUMI MOTOHIRA, KOICHI KITAZAWA (Tokyo, University, Japan), JUN-ICHI TAKEYA, and SHIRABE AKITA (Central Research Institute of Electric Power Industry, Tokyo, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 15, 1991, p. L1635-L1637. refs Copyright

The resistive state in single-crystal $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_y$ with field applied perpendicular to the c-axis has been studied to investigate the origin of the Lorentz-force-independent dissipation. It was observed that the current-voltage characteristics obey a power law in the higher current density region in the experiment (J above 20 A/sq cm), and that the power-law exponent and the resistivity show an unusual dependence on the magnetic field. These observations strongly suggest that a Kosterlitz-Thouless-type mechanism plays an essential role in the Lorentz-force-independent dissipation.

Author

A92-14178

NOVEL CHEMICAL ANALYSIS FOR THIN FILMS - SCANNING ELECTRON MICROSCOPY AND TOTAL-REFLECTION-ANGLE X-RAY SPECTROSCOPY (SEM-TRAXS) - X-RAY TAKE-OFF ANGLE EFFECT

TOSHIO USUI, MASAYUKI KAMEI, YUJI AOKI, TADATAKA MORISHITA, and SHOJI TANAKA (ISTEC, Superconductivity Research Laboratory, Tokyo, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Sept. 15, 1991, p. L1689-L1691. refs Copyright

Scanning electron microscopy and total-reflection-angle X-ray spectroscopy (SEM-TRAXS) was applied for fluorescence X-ray analysis of 50 Å- and 125 Å-thick Au thin films on Si(100). The intensity of the AuM line (2.15 keV) emitted from the Au thin films varied as a function of the take-off angle (θ_{sub}) with respect to the film surface; the intensity of AuM line from the 125 Å-thick Au thin film was 1.5 times as large as that of SiK-alpha line (1.74 keV) emitted from the Si substrate when θ_{sub} is 0-3 deg, in the vicinity of a critical angle for total external reflection of the AuM line at Si (0.81 deg). In addition, the intensity of the AuM line emitted from the 50 Å-thick Au thin film was also sufficiently strong for chemical analysis.

Author

A92-14917

DYNAMIC REFLECTION HIGH-ENERGY ELECTRON DIFFRACTION OBSERVATION OF 3C-SiC(001) SURFACE RECONSTRUCTION UNDER Si_2H_6 BEAM IRRADIATION

TATSUO YOSHINOBU, IWAO IZUMIKAWA, HIDEAKI MITSUI, TAKASHI FUYUKI, and HIROYUKI MATSUNAMI (Kyoto University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Nov. 25, 1991, p. 2844-2846. Research supported by MOESC. refs Copyright

A92-14921

LASRGaO₄ SUBSTRATE GIVES ORIENTED CRYSTALLINE YBa₂Cu₃O_{7-y} FILMS

S. HONTSU, J. ISHII (Kinki University, Higashiosaka, Japan), T. KAWAI, and S. KAWAI (Osaka University, Ibaraki, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Nov. 25, 1991, p. 2886-2888. refs Copyright

As-grown $\text{YBa}_2\text{Cu}_3\text{O}_{7-y}$ (YBCO) thin films of 70-nm thickness have been prepared on LaSrGaO_4 001-plane, 100-plane, and 110-plane single-crystal substrates at 700 °C using ArF laser-ablation deposition. The c-axis oriented thin films with smooth surface morphology are obtained on LaSrGaO_4 001-plane and 100-plane substrates. The zero resistance temperatures (T_c) of the films on the 001-plane and 100-plane substrates are 90.0 K, and 88.1 K, respectively. On the 110-plane substrate, 110-plane YBCO planes grown epitaxially. The resistance perpendicular to

the c axis in this film is 1/3 of that parallel to the c axis. These results suggest that a LaSrGaO_4 substrate having a low dielectric constant is a good substrate for the epitaxial growth and device application of high- T_c $\text{YBa}_2\text{Cu}_3\text{O}_{7-y}$ superconducting films.

Author

A92-14947

SOLID-LIQUID INTERFACIAL ENERGY OF THE $\text{Bi}_{0.7}\text{Pb}_{0.3}\text{SrCaCu}_{1.8}\text{O}_x$ GLASS

YOSHITAKE NISHI, TOYOHISA MANABE, SHIGEMI WATANABE, AKIRA IGARASHI, and KAORU MIKAGI (Tokai University, Hiratsuka, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, pt. 1, Nov. 15, 1991, p. 5684-5687. refs Copyright

The solid-liquid interfacial energy Q is estimated to be 74.7 mJ/sq m using measured nucleation frequency of $\text{Bi}_{0.7}\text{Pb}_{0.3}\text{SrCaCu}_{1.8}\text{O}_x$ glass. The temperature-independent Q values are obtained. The method used to estimate the Q value, involving atom diffusivity in supercooled liquid obtained using the calculated viscosity at various temperatures between the melting point and the glass transition temperature, is described.

C.D.

A92-14949

INTERACTION OF THE RESIDUAL HYDROGEN GAS WITH THE GROWTH OF $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ FILMS UNDER HIGH VACUUM

M. KAMEI, I. YOSHIDA, T. MORISHITA, and S. TANAKA (International Superconductivity Technology Research Center, Tokyo, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 70, pt. 1, Nov. 15, 1991, p. 5703-5705. Research supported by New Energy and Industrial Technology Development Organization. refs Copyright

$\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ films were fabricated by a reactive evaporation method using 10-mol-pct O_3 gas as an oxygen source. Mass spectroscopy measurement revealed that hydrogen gas was ejected from Y metal and Ba metal sources during evaporation. $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film growth was adversely affected by the existence of this hydrogen gas, confirmed by in situ reflection high-energy electron diffraction (RHEED) observation. A streak RHEED pattern was maintained throughout evaporation only when the hydrogen partial pressure was smaller than 1×10^{-6} Torr. Only films grown under this condition showed superconducting behavior.

Author

A92-16470

INERTIA EFFECT IN TWO-DIMENSIONAL MHD CHANNEL FLOW UNDER A TRAVELING SINE WAVE MAGNETIC FIELD

KAZUYUKI UENO (Kyoto University, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 3, Dec. 1991, p. 3107-3116. refs Copyright

The inertia effect peculiar to the MHD flow under a traveling sine wave transverse magnetic field between two parallel walls is investigated analytically and numerically. Solutions for steady flow of incompressible viscous fluid are obtained using a coordinate system moving with the traveling magnetic field. Three categories of flow, classified by interaction parameter N , are considered.

Author

A92-17370

VISIBLE PHOTOLUMINESCENCE OF GE MICROCRYSTALS EMBEDDED IN SiO_2 GLASSY MATRICES

YOSHIHITO MAEDA, NOBUO TSUKAMOTO, YOSHIKI YAZAWA (Hitachi, Ltd., Hitachi Research Laboratory, Japan), YOSHIHIKO KANEMITSU, and YASUAKI MASUMOTO (Tsukuba, University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 9, 1991, p. 3168-3170. refs Copyright

Ge microcrystals embedded in SiO_2 glassy matrices were formed by a radio-frequency magnetron cosputtering technique and then annealed at 800 °C for 30 min. The average radius of the Ge microcrystals in SiO_2 was determined to be about 3 nm by means of Raman spectroscopy and high resolution electron

microscope. The annealed sample showed a strong room temperature luminescence with a peak at 2.18 eV. This is consistent with quantum confinement of electrons and holes. Author

A92-17375

INTRODUCTION OF PINNING CENTERS INTO TL-(1223) PHASE OF TL-SR-CA-CU-O SYSTEMS

TOMOICHI KAMO, TOSHIYA DOI, ATSUKO SOETA, TOYOTAKA YUASA, NAOMI INOUE, KATSUZO AIHARA, and SHIN-PEI MATSUDA (Hitachi, Ltd., Hitachi Research Laboratory, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 9, 1991, p. 3186-3188. refs

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Pinning centers were successfully introduced into the (1223) phase of Ti-Sr-Ca-Cu-O system using its derivative (Ti/Pb)-(Sr/Ba)-Ca-Cu-O with the nominal composition of (0.5/0.5) - (1.6/0.4)-2-3. The bulk sample showed a strong flux pinning characteristics. The critical current density, J_c , was obtained from the magnetization measurement. The intragrain J_c was about 43,000 A/sq cm at 77 K and 1 T. The transport J_c of a tape with the (1223) material in core was about 500 A/sq cm at 77 K and 5 T. Author

A92-17401

FERROELECTRIC MATERIALS AND THEIR APPLICATIONS; PROCEEDINGS OF THE 8TH MEETING, KYOTO, JAPAN, MAY 29-31, 1991

YOSHIHIRO ISHIBASHI, ED. (Nagoya University, Japan), TADASHI SHIOSAKI, ED. (Kyoto University, Japan), KATSUMI YOSHINO, ED. (Osaka University, Suita, Japan), and NOBORU ICHINOSE, ED. (Waseda University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, 285 p. For individual items see A92-17402 to A92-17420.

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Papers included in this volume are grouped under topics of thin films, piezoelectrics, ferroelectrics, dielectric properties, optical applications, and fundamentals. Papers are presented on the preparation and properties of lead zirconate-titanate thin films, PbTiO₃ thin films deposited by laser ablation, properties of piezoelectric ceramics sintered in reducing atmosphere, and properties of hydrophone with porous piezoelectric ceramics. Attention is also given to the relationship between crystal structure and long-time response to dc electric field in niobium-doped BaTiO₃ ceramics, the preparation and piezoelectric properties of ceramics-plastic composite materials, dielectric properties of lead alkaline-earth zirconate at microwave frequencies, an optical logic element using ferroelectric liquid crystal with electrical feedback, and the effect of atmosphere on the wetting of BaTiO₃ by electrode metals. I.S.

A92-17402

HIGHLY C-AXIS-ORIENTED PB(ZR,TI)O₃ FILMS PREPARED BY SPUTTERING

TATSUO FUKAMI, ISAMU MINEMURA, YASUSHI HIROSHIMA, and TOSHIYUKI OSADA (Shinshu University, Nagano, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2155-2158. refs

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A newly developed tripole magnetron sputtering system, which has a third magnetic pole, has been applied to deposit PZT films in the atomic layer epitaxy mode. A set of experimental results revealed that the resultant films were highly c-axis orientated on (100) MgO substrates and that the deviation from stoichiometry in the films enhanced asymmetric properties of the P-E loop patterns. Author

A92-17403

PREPARATION OF TUNGSTEN-BRONZE THIN FILMS

MASATOSHI ADACHI, AKIRA KAWABATA (Toyama Prefectural University, Japan), and FUMIO TAKEDA (Toyama National College of Technology, Japan) (Ferroelectric materials and their

applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2208-2211. refs

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The paper describes the preparation of ferroelectric tungsten-bronze thin films, including Pb(0.6)Ba(0.4)Nb₂O₆ (PBN), Pb₂KNb₅O₁₅, K₃Li₂Nb₅O₁₅, K(2.7)Na(0.3)Li₂Nb₅O₁₅, and K₂BiNb₅O₁₅ films, by sputter deposition on sapphire and fused-quartz substrates using ceramic targets. It was found that (001)-oriented epitaxial PBN films could be successfully grown on (0 1 -1 2) sapphire substrates at temperature around 650 C, but could not be grown in the tungsten-bronze phase because of a significant K deficiency in the sputtered films during the growth. I.S.

A92-17405

SEARCH FOR A MATERIAL WITH TEMPERATURE-INDEPENDENT PIEZOELECTRIC CONSTANT D₃₁ IN NB-MODIFIED PB(ZR,TI)O₃ CERAMICS

MASARU YOKOSUKA, MASAKAZU MARUTAKE (Iwaki-Mesei University, Iwaki, Japan), and TUTOMU OCHIAI (Kobayashi Institute of Physical Research, Kokubunji, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2228-2231. refs

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A92-17406

PB(ZN(1/3)NB(2/3))O₃-BASED PIEZOELECTRIC AND ELECTROSTRICTIVE CERAMICS

TOSHIO KANEGAE, KOICHIRO SAKATA, and TADASHI TAKENAKA (Tokyo, Science University, Noda, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2232-2235. refs

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Ceramics based on Pb(Zn(1/3)Nb(2/3))O₃ (PZN) with perovskite structure were prepared by a modification of La(Ni(1/2)Ti(1/2))O₃ (LNT) or La(Co(1/2)Ti(1/2))O₃ (LCT), and the effects of the suppression of the pyrochlore phase on the dielectric and electrostrictive properties were investigated. Results showed that PZN-based ceramics with LNT or LCT modification are suitable for use as electrostrictive materials with little hysteresis and adequate temperature stability in the vicinity of room temperature. I.S.

A92-17407

(BI(1/2)NA(1/2))TiO₃-BATiO₃ SYSTEM FOR LEAD-FREE PIEZOELECTRIC CERAMICS

TADASHI TAKENAKA, KEI-ICHI MARUYAMA, and KOICHIRO SAKATA (Tokyo, Science University, Noda, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2236-2239. refs

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One of the (Bi(1/2)Na(1/2))TiO₃ (BNT)-based solid solutions, Ba-modified bismuth sodium titanate, (Bi(1/2)Na(1/2))(1-x)Ba(x)TiO₃ (BNBT), is studied for its dielectric and piezoelectric properties as a new group of lead-free piezoelectric ceramics. A rhombohedral (F sub alpha)-tetragonal (F sub beta) morphotropic phase boundary (MPB) is shown to exist at x = 0.06-0.07 by X-ray data, and dielectric and piezoelectric properties. BNBT ceramics with the MPB composition are superior as piezoelectric ceramics in high-frequency ultrasonic applications or as piezoelectric actuator materials because of a lower free permittivity, and a high electromechanical coupling factor, along with high mechanical strength. Author

A92-17408**PIEZOELECTRIC PROPERTIES OF 0-3 COMPOSITE OF POLYMER AND CERAMIC POWDER MIXTURE OF PZT AND PBTIO3**

HISAO BANNO and KOHJI OGURA (NGK Spark Plug Co., Ltd., Nagoya, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2247-2249. refs Copyright

The effects of the ceramic volume fraction and the ceramic-powder mixture ratio on the piezoelectric properties of a 0-3 composite consisting of a polymer and a ceramic-powder mixture of PZT and PbTiO₃ (PT) with almost the same or different ratios of ceramic particle sizes were investigated. It was found that hydrostatic piezoelectric constants d_{31} of PZT/PT composites exhibited enhanced values in a mixture with 70 percent ceramic volume and in which the PZT and PT particle sizes were in the ratio PZT/PT $\approx$ 7.7 microns/3.3 microns; no enhancement was found in composites consisting of ceramic powder mixture of almost identical particle size. I.S.

A92-17409**RELATIONS BETWEEN PIEZOELECTRIC PROPERTIES AND MICROSTRUCTURE IN POLED PIEZOELECTRIC CERAMICS BY APPLIED UNIAXIAL COMPRESSIVE STRESS**

TAKASHI YAMAMOTO (National Defense Academy, Yokosuka, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2256-2259. refs Copyright

A92-17416**DIELECTRIC PROPERTIES OF DOUBLE-OXIDE CERAMICS IN THE SYSTEM LN2O3-TiO2 (LN = LA, ND AND SM)**

JUNICHI TAKAHASHI (Nagoya Institute of Technology, Japan), KEISUKE KAGEYAMA (Sumitomo Special Metals Co., Ltd., Yamasaki Works, Osaka, Japan), and TAKASHI HAYASHI (Shonan Institute of Technology, Fujisawa, Japan) (Ferroelectric materials and their applications; Proceedings of the 8th Meeting, Kyoto, Japan, May 29-31, 1991. A92-17401 05-76) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Sept. 1991, p. 2354-2358. refs Copyright

The effect of compositional variation in Ln₂O₃-TiO₂ double-oxide ceramics (where Ln = La, Nd, or Sm) on the dielectric properties of this system, particularly of ceramics with the compositions Ln₂O₃:TiO₂ = 1:2 and 2:9 and of solid solutions containing different lanthanide ions. It was found that the temperature coefficient of permittivity TC(epsilon-r) for these dielectrics deviated considerably from a simple relation observed in many ceramics, where TC(epsilon-r) equals the product between -(epsilon-r) and (alpha-L). Dielectric property changes with the lanthanide substitution were detailed for different series of the solid solutions and were found to be different for each crystal system. I.S.

A92-17570**IMPROVEMENT OF ORGANOMETALLIC VAPOR PHASE EPITAXY REGROWN GAINAS/INP HETEROINTERFACE BY SURFACE TREATMENT**

TAKASHI SUEMASU, YASUYUKI MIYAMOTO, and KAZUHITO FURUYA (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Oct. 1, 1991, p. L1702-L1704. Research supported by MOESC. refs Copyright

It is shown that the combined surface treatment of a (NH₄)₂S(x) treatment and preheating improves the regrown heterointerface of n-GaInAs/i-InP in organometallic vapor phase epitaxy. Properties of the regrown heterointerface were evaluated from voltage-current characteristics of the n-GaInAs/i-InP/n-GaInAs tunneling diode.

This surface treatment is useful for the fabrication of ultrafine-size structures of quantum-wire, quantum-box, and electron-wave devices. Author

A92-17936**TORQUE STUDY OF LAYERED SUPERCONDUCTING OXIDE Bi2Sr2CaCu2O(8+DELTA) SINGLE CRYSTAL**

KIICHI OKUDA, SHUICHI KAWAMATA, SATORU NOGUCHI, NOBUTAKA ITOH (Osaka Prefecture University, Sakai, Japan), and KAZUO KADOWAKI (National Research Institute for Metals, Tsukuba, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Oct. 1991, p. 3226-3229. refs Copyright

Magnetic anisotropy of layered superconducting oxide Bi₂Sr₂CaCu₂O(8+delta) single crystal was investigated by torque measurements at 77 K. A hysteresis loop with a sharp cusp was found for the magnetic fields below about 6 kOe close to the ab-plane. It can be satisfactorily explained by assuming that the component of diamagnetic moment perpendicular to the ab-plane is induced by the applied external field. In fact, the field and angular dependence of the cusp is ruled well by the relation $H \cos \theta = H_{cp}$, where H_{cp} is the critical field perpendicular to the ab-plane at which the flux-pinning decreases abruptly with increasing field. Author

A92-18842**GROWTH OF (110)-ORIENTED CeO2 LAYERS ON (100) SILICON SUBSTRATES**

T. INOUE, T. OHSUNA (Iwaki Meisei University, Japan), L. LUO, X. D. WU, C. J. MAGGIORE (Los Alamos National Laboratory, NM), Y. YAMAMOTO, Y. SAKURAI, and J. H. CHANG (Hosei University, Koganei, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 30, 1991, p. 3604-3606. Research supported by DOE. refs Copyright

Results are reported of cross-sectional HRTEM, electron diffraction, and XRD studies of the CeO₂(110)/Si(100) structure obtained by epitaxially growing CeO₂ layers on (100) silicon substrates, using electron-beam evaporation. The HRTEM observations also showed the existence of a 60-A-thick intermediate amorphous layer between CeO₂ and silicon substrate, as well as high-density defects in the CeO₂ layers near the interfaces. I.S.

A92-18848**LOW-ENERGY ION SCATTERING SPECTROSCOPY OBSERVATIONS OF C-AXIS-ORIENTED YBa2Cu3O(7-x) THIN FILMS - EFFECTS OF IN-VACUUM ANNEALING**

S. TANAKA, T. NAKAMURA, M. IYAMA, N. YOSHIDA, S. TAKANO (Sumitomo Electric Industries, Ltd., Osaka, Japan), F. SHOJI, and K. OURA (Osaka University, Suita, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Dec. 30, 1991, p. 3637-3639. refs Copyright

The atomic structure of (001) surfaces of c-axis-oriented YBa₂Cu₃O(7-x) (YBCO) thin films was studied by low-energy ion scattering spectroscopy (ISS) after annealing in ultrahigh vacuum. This is the first report on the surface analysis of superconducting oxide evaluated by ISS. A clean surface of YBCO (001) 1 x 1 is produced by annealing at around 500 C. The surface structure is discussed in terms of the blocking and the nonblocking effects caused by the desorption of O(4) atoms. It is concluded that the (001) surfaces are stabilized by Cu(1)-O chains. Author

A92-18928**PREPARATION AND SUPERCONDUCTING PROPERTIES OF TLBASRCACUO SYSTEM**

MASANORI KURODA and KIYOSHI YOKOGAWA (Government Industrial Research Institute, Kure, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1871, L1872. refs Copyright

The effect of calcining and heating temperature on the structure and superconductivity of the TI-based superconductors,

TiBaSrCaCuO is reported. It was found that a CuO₂ three-layer nearly single phase (1223 phase) was obtained at heating temperature over 865 C, and CuO₂ two-layer phases (2212 and 1212 phases) were obtained at heating temperature under 860 C.

Author

A92-18930

PLASMA OXIDATION OF COPPER THIN FILMS

WATARU ITO, HARUO SHIMADA, MUNYUKI IMAFUKU, and MISAO HASHIMOTO (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1877-L1880. refs

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The cause for the observation by Shimada and Murata (1985) of an unexpected change in the sample current during heating of multilayered YBCO films in oxidizing plasma is investigated by comparing the sample current density changes during plasma oxidation of YBCO films and thin copper films, using a specially designed set-up described by Ito et al. (1990). The results showed a close similarity between the two samples, suggesting that the changes in current during the plasma oxidation are due to the oxidation of copper to copper oxide. It was also found that the oxidation process proceeded at a temperature lower than that needed for the construction of the YBCO structure, and there was still a small amount of metallic copper remaining even in the case of high-T_c sputter-deposited YBCO films.

I.S.

A92-18934

VAN DER WAALS EPITAXIAL GROWTH OF C60 FILM ON A CLEAVED FACE OF MOS2

MASATOSHI SAKURAI, HIROKAZU TADA, KOICHIRO SAIKI, and ATSUSHI KOMA (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Nov. 1, 1991, p. L1892-L1894. refs

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C60 film has been grown heteroepitaxially on a cleaved face of MoS₂ by means of van der Waals epitaxy. The C60 film forms a close-packed structure with its principal crystal axes parallel to those of the substrate. Although the lattice constant of the C60 crystal is much larger than that of MoS₂, good heteroepitaxial growth becomes possible because of the van der Waals-type interaction between the grown film and the substrate.

Author

A92-19363

POLISHING OF YBa₂Cu₃O_{7-y} BY HE-ION ETCHING

NORIYUKI INOUE, YASUO TAKAHASHI, TAKASHI SUDO, KAGEYOSHI SAKAMOTO, TOSHIO SHIMA, and YOSHITAKE NISHI (Tokai University, Hiratsuka, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, Jan. 1, 1992, p. 347-349. refs

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Clean polishing is performed by helium-ion etching on a surface of high-T_c YBa₂Cu₃O_{7-y}. Based on a knock-on cascade model, the decrease of surface roughness is discussed. A rate process of etching is applied for the surface roughness of the high-T_c YBa₂Cu₃O_{7-y}.

Author

A92-19365

PHOTOINTERCALATION CHARACTERISTICS OF THIN WO₃ FILMS

MASAHIRO NAGASU and NOBUYOSHI KOSHIDA (Tokyo University of Agriculture and Technology, Koganei, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, Jan. 1, 1992, p. 398-402. Research supported by MOESC. refs

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Photoinduced proton injection properties of amorphous thin WO₃ films have been studied for a cell of the form coated glass/semitransparent Au/ethanol/WO₃/indium-tin-oxide-coated glass. When the cell was illuminated with near-uv light through a quartz window under open circuit conditions, a definite reversible change was induced in the optical and electrical properties of

WO₃ films. On the basis of some experimental analyses, this effect is attributed to photointercalation (PI) of protons into WO₃ films. It is also demonstrated that WO₃-based PI cells efficiently operate as an erasable device for storage and modulation of optical information.

Author

A92-19369

FABRICATION OF GAAS QUANTUM WIRES ON EPITAXIALLY GROWN V GROOVES BY METAL-ORGANIC CHEMICAL-VAPOR DEPOSITION

S. TSUKAMOTO, Y. NAGAMUNE, M. NISHIOKA, and Y. ARAKAWA (Tokyo, University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, Jan. 1, 1992, p. 533-535. Research supported by University-Industry Joint Project on Mesoscopic Electronics and MOESC. refs

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Successful fabrication of thin GaAs quantum wires (120-200 Å) x (200-300 Å) by a novel metal-organic chemical-vapor-deposition growth technique is reported. The GaAs quantum wires were grown on a V groove formed by two GaAs triangular prisms which were selectively grown on SiO₂ masked substrates. The V groove has a very sharp corner at the bottom, which results in reduction of the effective width of the quantum wire structures. The measurement of photoluminescence and photoluminescence excitation spectra with polarization dependence indicate the existence of the quantized state in the quantum wires.

Author

A92-20031

OXYGEN DIFFUSION INTO DIAMOND INDUCED BY HYDROGEN MICROWAVE PLASMA

Y. MORI, N. EIMORI, H. KOZUKA, Y. YOKOTA, J. MOON, J. S. MA, T. ITO, and A. HIRAKI (Osaka University, Suita, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 6, 1992, p. 47-49. Research supported by MOESC. refs

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Diffusion of oxygen atoms into diamond can be introduced by CrO₃ treatment followed by an exposure to a hydrogen plasma. From characterization using Rutherford backscattering spectrometry, it is found that the depth distribution of the doped oxygen in the diamond is homogeneous from the surface where its concentration is about 10 exp 20 atoms/cu cm. The doped oxygen can form cathodoluminescence centers yielding luminescence peaks at 3.75 and 4.64 eV at room temperature. After the diffusion of oxygen atoms, damages in the diamond cannot be detected by Raman scattering spectroscopy.

Author

A92-20038

HIGHLY ORIENTED YBa₂Cu₄O₈ FILMS FABRICATED AT ATMOSPHERIC PRESSURE BY THE SOL-GEL METHOD USING METAL ALKOXIDES

SHINGO KATAYAMA, MASAHIRO SEKINE (Colloid Research Institute, Kitakyushu, Japan), HIROSHI FUDOUZI, and MAKOTO KUWABARA (Kyushu Institute of Technology, Kitakyushu, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 6, 1992, p. 118, 119. Research supported by Japan Key Technology Center. refs

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YBa₂Cu₄O₈ films were fabricated at atmospheric pressure by the sol-gel method using metal alkoxides. Gel films on Ag substrates, prepared from a heterometallic alkoxide solution, were fired at 800 C for 10h to yield highly oriented YBa₂Cu₄O₈ films. Simultaneously using both the sol-gel method and Ag as a substrate was found to be remarkably effective for promoting the formation of the YBa₂Cu₄O₈ phase and producing highly oriented films.

Author

A92-20525

TRANSMISSION ELECTRON MICROSCOPY STUDY OF CHEMICAL-VAPOR-DEPOSITED DIAMOND BY A SIDE-VIEW METHOD

YASUYUKI GOTO, KAZUAKI KURIHARA, YUMIKO SAWAMOTO, and TOSHISUKE KITAKOHJI (Fujitsu Laboratories, Ltd., Atsugi,

Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 13, 1992, p. 172, 173. refs
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The initial growth of synthetic diamond by dc plasma-jet chemical vapor deposition was studied with a transmission electron microscope by a side-view method. Both diamond particles and beta-SiC particles were observed on the Si substrate. Si atoms in the substrate were etched clearly by the plasma jet except beneath diamond particles. Author

A92-21114

GROWTH MECHANISM OF YBa₂Cu₃O₇(Y) SUPERCONDUCTORS PREPARED BY THE HORIZONTAL BRIDGMAN METHOD

TERUO IZUMI and YUH SHIOHARA (International Superconductivity Technology Center, Tokyo, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, Jan. 1992, p. 16-23. Research supported by New Energy and Industrial Technology Development Organization. refs
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An investigation is made of the effect of the temperature gradient (G)/growth rate (R) value on the crystal alignment and crystallization mechanism of the 123 superconductor YBa₂Cu₃O₇(y) from the partially-melted state, in the case of the Bridgman crystallization method. The G/R limit for continuous growth of textured-structure samples was confirmed to lie in the 301-482 Ch/sq cm range; the 123 grains grown under a G/R condition below the lower limit became coarser with decreasing cooling rate. Entrapment of 211 particles in the growing 123 crystals occurs after significant coarsening of the particles in the liquid. O.C.

A92-21726

Hg(1-x)Cd(x)Te SURFACE AFTER CHEMICAL ETCHING AND ELECTROCHEMICAL REDUCTION

KENGO SHIMANO and MASAO SAKASHITA (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Nov. 1991, p. 2723-2729. refs
Copyright

An angle-dependent XPS technique is used to investigate surface compositions of Hg(1-x)Cd(x)Te (MCT). The degree of oxidation formed after the chemical etching in Br₂-methanol solutions is found to be dependent on the Br₂ concentration but independent of etching time. The etched surface is Te-rich. The hypothesis that the electrochemically reduced surface is more stable in atmospheric oxygen than the chemically etched MCT is confirmed. P.D.

A92-21729

STRUCTURE AND MORPHOLOGY OF SOLID C₆₀/C₇₀ AND C₆₀ GROWN FROM BENZENE SOLUTION

YAHACHI SAITO, HISANORI SHINOHARA (Mie University, Tsu, Japan), NORITOMO SUZUKI (Toyota Central Research and Development Laboratories, Inc., Japan), and YOSHINORI ANDO (Meijo University, Nagoya, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Nov. 1991, p. 2857-2862. Research supported by Yamada Science Foundation. refs
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Crystallites of C₆₀/C₇₀ mixture and pure C₆₀ have been produced from benzene solution by evaporating the benzene solvent. The new forms of solid carbon have been examined by electron microscopy with particular attention to the structure of crystallites with platelet shape. Electron diffraction patterns and high-resolution images reveal that they have an hcp structure (a = 10.1 +/- 0.1 Å, c = 16.5 +/- 0.2 Å) with stacking faults of molecular layers perpendicular to the c-axis. Author

A92-21953

DIELECTRIC ANOMALIES AND PHOTOCONDUCTIVITY IN HOST INSULATOR CU₂O CORRELATIVE WITH HIGH-TC SUPERCONDUCTIVITY

TAIZO MASUMI (Tokyo, University, Japan) Physical Society of

Japan, Journal (ISSN 0031-9015), vol. 60, Nov. 1991, p. 3625-3628. Research supported by MOESC. refs
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Dielectric anomalies have been recognized in temperature dependences of the dark dielectric response $\kappa(T)$ and also the transient photoconductivity $Q(T, \lambda)$ of insulating crystals of cuprous oxide Cu₂O. Unlike submerging characters of normal photoconductivity in most insulators, Cu₂O exhibits a series of steplike emergences of $Q(T)$ with decreasing T in correspondence with the dielectric anomalies in $\kappa(T)$ characteristic to electronic phase transitions. Anomalies in $\kappa(T)$ and the step temperatures T sub pS in $Q(T, \lambda)$ of Cu₂O are, via the Y-Cu-O, La-Cu-O, correlated with the critical temperatures of superconductivity in rho(T) of the Cu-based oxides such as the Y-Ba-Cu-O, La-Ba-Cu-O systems. Thus, Cu₂O can be considered to be the 'basic host insulator' relevant to the Cu-based superconductors. Therefore, such an anomalous photoconductivity $Q(T)$ discovered in Cu₂O, Y-Cu-O, La-Cu-O as well over all host insulators of the Cu-based superconductors can be called 'superconductive conjugate photoconductivity'. Author

A92-21954

AN OBSERVATION OF QUANTIZED SERIES OF STEP OR CLEW TEMPERATURES IN SUPERCONDUCTIVE-CONJUGATE PHOTOCONDUCTIVITY OF CU₂O

TAIZO MASUMI and HIROSHI SHIMADA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Nov. 1991, p. 3633-3636. Research supported by MOESC. refs
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Details of the temperature dependences of transient photoconductivity $Q(T, \lambda)$ with that of Hall mobility mu sub H(T) of photoexcited carriers in Cu₂O at low-power level of lambda sub ex = 570-735 nm have been reexamined over a wide temperature range between 4.2 and 300 K, in order to clarify the natures of 'superconductive-conjugate photoconductivity'. Selective optical excitation at low levels of lambda sub ex = 570-750 nm creates either a free electron and a positive hole or mainly free holes in Cu₂O. By carefully analyzing these data, it was recognized for the first time that there exists a novel quantized series of 'step temperatures T sub pS' in $Q(T, \lambda)$ with 'clew temperatures T sub pC', in the photoexcited holes density in Cu₂O as T decreases. A series of the values of T sub pS or T sub pC is possibly ruled by a type of condensation of valence electrons and free photocarriers into new states mediated via surrounding intraband CT-excitons of Cu₂O. Here, a new concept of 'the excitonic isomer shift of superconductive T sub sC' is proposed. Author

A92-21995

Y₂O₃ SINGLE CRYSTALLINE SUBSTRATE FOR EPITAXIAL GROWTH OF HIGH TC SUPERCONDUCTING THIN FILMS

A. OISHI, H. TESHIMA, K. OHATA, H. IZUMI, S. KAWAMOTO, T. MORISHITA, and S. TANAKA (ISTEC, Superconductivity Research Laboratory, Tokyo, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 59, Oct. 7, 1991, p. 1902-1904. refs
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The applicability of Y₂O₃ single-crystal (001) substrates for epitaxial growth of c-axis oriented high-Tc YBa₂Cu₃O_{7-x} (YBCO) films is demonstrated. The in-plane orientation between YBCO and Y₂O₃ was found to be 110-line-type YBCO parallel to the 100-line-type Y₂O₃, and the interface between YBCO and Y₂O₃ to be very sharp and chemically stable. The film deposited on Y₂O₃ substrates exhibited Tc = 86.2 K; Delta-T = 1.2 K; and Jc = 1.4 x 10 exp 7 and 2.0 x 10 exp 6 A/sq cm in magnetic fields of 0 and 5 T (at 5K), respectively. I.S.

A92-22007

TRANSPORT CRITICAL CURRENTS IN FIELD-ORIENTED Y₁Ba₂Cu₃O₇(Y) POLYCRYSTALS

Y. NAKAGAWA, H. YAMASAKI, M. UMEDA, and S. KOSAKA (Electrotechnical Laboratory, Tsukuba, Japan) Journal of Applied

Physics (ISSN 0021-8979), vol. 71, Jan. 15, 1992, p. 800-807. refs

Copyright

Field-oriented Y1Ba2Cu3O(y) samples with various values of Jc have been prepared with various heat treatments. The Jc increased rapidly with an increase in relative sintered density of the oriented samples. The field-oriented samples with higher Jc had grains of larger sizes and better connections between the neighboring grains than the low Jc samples. The maximum values of Jc at a magnetic field of 7 T were 370 A/sq cm at 4.2 K and 24 A/sq cm at 77 K. The hysteresis in the Jc-H curves at 4.2 K decreased with an increase in Jc both for an applied field H perpendicular to ab plane and for H perpendicular to c axis. The critical currents of the samples with higher Jc were less degraded by aging in the air for 1 year than those of the low Jc samples.

Author

A92-22067

HIGH-QUALITY SUPERCONDUCTING THIN FILMS OF Bi2Sr2Ca2Cu3O(x) GROWN IN SITU BY METALORGANIC CVD

K. ENDO, H. YAMASAKI, S. MISAWA, S. YOSHIDA, and K. KAJIMURA (Electrotechnical Laboratory, Tsukuba, Japan) Nature (ISSN 0028-0836), vol. 355, Jan. 23, 1992, p. 327, 328. refs

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The preparation and properties of c-axis-oriented single-phase Bi2Sr2Ca2Cu3O(x) films grown in situ without postannealing by MOCVD are reported. The films have the highest Tc and Jc at 77 K reported so far for Bi-Sr-Ca-Cu-O films grown in situ; one film had a zero-resistance Tc of 97 K and a Jc of 3.8×10^5 A/sq cm at 77 K in zero magnetic field. This film showed little degradation of Jc in magnetic fields of up to 8 T applied parallel to the crystallographic a-b plane. The magnetic-field dependence of Jc and observed surface morphologies strongly suggest that these as-grown films have no weak links, which is a promising characteristic for device applications.

C.D.

A92-22079

DOPING EFFECTS OF METALLIC ELEMENTS ON THE SUPERCONDUCTIVITY IN THE TL-Ba-Ca-Cu-O SYSTEM

KOUKI JYODOI, AKIHISA SONODA, SIGEYUKI YASUYAMA, and AKIRA OHYOSHI (Kumamoto University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2021-L2024. refs

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The effects of various metallic dopants on the superconductivity of the Ti-Ba-Ca-Cu-O system have been investigated. Metals (Zn, Cd, Al, In, Pb and Bi) control the rate of solid-state reaction and the volatility of Ti components. Increases in the electrical conductivity at room temperature and the superconducting volume fraction were achieved as the result of metallic doping. It is considered that metals promote the intergranular coupling of the superconductive particle and annihilate the ceramic pores in the sintering process.

Author

A92-22080

ANOMALOUS CRITICAL TEMPERATURE OVER 200 K IN MULTIPHASE TL-Ba-Ca-Cu-O SYSTEM

KOUKI JYODOI, KEIJI FUKUSHIMA, AKIHISA SONODA, SIGEYUKI YASUYAMA, and AKIRA OHYOSHI (Kumamoto University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2025-L2027. refs

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Anomalous critical temperatures of over 200 K were recorded for multiphase samples with the nominal composition of TiBa2Ca3Cu4O(10.5). The formation of the samples was found to be critically dependent on the sintering temperature and time. The results of energy dispersive X-ray spectrometry analysis showed that the atomic ratios for these samples were Ti:Ba:Ca:Cu = 0.19 +/0.05:1.94 +/0.09:2.63 +/0.16:4.00. The X-ray photoelectron spectroscopy spectra of Ti4f, Ba3d, Cu2p, and O1s partially consisted of high-binding-energy components. These are

interpreted as resulting from an electron transfer reaction such as $Ti_2O_3 + 2CuO \rightarrow 2Ti_2O + Cu_2O_3$.

Author

A92-22082

X-RAY CHEMICAL ANALYSIS OF AN YBa2Cu3O(x) THIN FILM BY SCANNING ELECTRON MICROSCOPY AND TOTAL-REFLECTION-ANGLE X-RAY SPECTROSCOPY (SEM-TRAXS)

TOSHIO USUI, YUJI AOKI, MASAYUKI KAMEI, HIROMI TAKAHASHI, TADATAKA MORISHITA, and SHOJI TANAKA (ISTEC, Superconductivity Research Laboratory, Tokyo, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2032-L2035. refs

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A92-22083

FERMI SURFACES OF ALKALI-METAL-DOPED C60 SOLID

NORIAKI HAMADA, SUSUMU SAITO, YOSHIYUKI MIYAMOTO, and ATSUSHI OSHIYAMA (NEC Corp., Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 1, 1991, p. L2036-L2038. refs

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The paper presents the first-principles electronic-structure calculation which demonstrates outstanding features in the Fermi surface of potassium-doped C60. It is shown that there exist two main Fermi surfaces: (1) a hole pocket around the center of the Brillouin zone, originating from the lower conduction band; and (2) a large hole surface extending to the zone boundary, which originates from the upper conduction band. The individual contributions of these surfaces to the Fermi-level DOS are 12 and 88 percent, respectively. Therefore, most properties related to the Fermi surface will be dominated by the second type of Fermi surface.

I.S.

A92-22732

COMPATIBLE MATERIALS WITH YBa2Cu3O(y)

S. KIKKAWA, F. KANAMARU (Osaka University, Japan), and S. HASHIGUCHI (Sumitomo Cement Co., Ltd., Tokyo, Japan) Journal of Materials Science Letters (ISSN 0261-8028), vol. 11, Jan. 1, 1992, p. 9, 10. Research supported by MOESC and Sumitomo Cement Co., Ltd. refs

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The hygroscopic properties of YBa2Cu3O(y) require overcoating with materials that remain nonreactive during the up to 900 C crystallization and oxygen annealing of superconducting thin films of this material. Reactions of this superconductor have been investigated with both alkaline-earth fluorides and several Ba compounds. BaF2 and BaZrO3 are identified as promising candidates for coatings.

O.C.

A92-22911

IMPROVED CRYSTALLINE QUALITY OF Si(1-x)Ge(x) FORMED BY LOW-TEMPERATURE GERMANIUM ION IMPLANTATION

KEN-ICHI SHOJI, AKIRA FUKAMI, TAKAHIRO NAGANO (Hitachi, Ltd., Hitachi Research Laboratory, Japan), TAKASHI TOKUYAMA (Tsukuba, University, Japan), and CARY Y. YANG (Santa Clara University, CA) Applied Physics Letters (ISSN 0003-6951), vol. 60, Jan. 27, 1992, p. 451-453. refs

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Improvement of crystalline quality in Si(1-x)Ge(x) formed by germanium ion implantation has been found. End-of-range defects were drastically reduced in number by lowering the substrate temperature during implantation with doses on the order of 10^{16} exp 16/sq cm. This improvement was confirmed by electrical characterization of p-n junctions formed in the SiGe layer as well as by transmission electron microscopy.

Author

A92-24033

A BIAS VOLTAGE DEPENDENCE OF TRAPPED HOLE ANNEALING AND ITS MEASUREMENT TECHNIQUE

S. KUBOYAMA, T. GOKA, and T. TAMURA (NASDA, Tsukuba Space Center, Japan) (1991 IEEE Annual Conference on Nuclear

and Space Radiation Effects, 28th, San Diego, CA, July 15-19, 1991, *Proceedings*. A92-24025 08-33) IEEE Transactions on Nuclear Science (ISSN 0018-9499), vol. 38, pt. 1, Dec. 1991, p. 1140-1144. refs

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A bias voltage dependence of the trapped hole annealing was observed by using a unique irradiation technique with a MOS capacitor which exhibits almost no annealing of the trapped holes at negative bias condition. The result showed the change of time scale for the annealing behavior with the Boltzmann's factor as a function of the surface potential of the substrate. This result suggests that the oxide of the MOS capacitor has a trap level positioned above the Si conduction band edge. Additional annealing experiments at several temperatures supported the results, and the position of the trap level was determined. The trap level confirmed may be one of the commonly observed levels, although it is a special case that the MOS capacitor has only the trap level. I.E.

A92-24994

SYNTHESIS OF A DIAMOND AND METAL MIXTURE BY THE CHEMICAL VAPOR DEPOSITION PROCESS

M. KAWARADA, K. KURIHARA, and K. SASAKI (Fujitsu Laboratories, Ltd., Atsugi, Japan) *Journal of Applied Physics* (ISSN 0021-8979), vol. 71, Feb. 1, 1992, p. 1442-1445. refs

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A mixture of diamond and metal film was synthesized by a hybrid process combining plasma-jet chemical vapor deposition and a plasma-spray process. Sprayed molybdenum and tungsten were changed to Mo₂C and tungsten carbide, respectively, and the lattice constants of Ni, Fe, and Co were increased by carbon-plasma spraying. Adhesion of film to the substrate was improved using the hybrid process to form a layer 50 to 150 microns thick of mixed metal and diamond between the substrate and pure diamond film. Author

A92-25115

ISOTOPE EFFECT ON SUPERCONDUCTIVITY IN RB3C60

T. W. EBBESEN, J. S. TSAI, K. TANIGAKI, J. TABUCHI, Y. SHIMAKAWA, Y. KUBO, I. HIROSAWA, and J. MIZUKI (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan) *Nature* (ISSN 0028-0836), vol. 355, Feb. 13, 1992, p. 620-622. refs

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To test whether the phonon that mediates electron pairing plays a part in controlling T_c for C₆₀ superconductors, C₆₀ was prepared containing various amounts of C-13, which was then doped with Rb to give Rb₃C₆₀. Measurements of diamagnetic shielding and Meissner effect show that T_c decreases as the C-13 content increases, as expected within the context of BCS-like phonon-mediated pairing; but the dependence on the mass is stronger than for most electron-phonon superconductors: the exponent alpha has the remarkably large value of 1.4 +/- 0.5. Regardless of the interpretation of this value, it is clear that phonons have an important role in the origin of superconductivity in doped C₆₀. C.D.

A92-25426

AN APPROACH TO THE GROWTH OF YBa₂Cu₃O_{7-x} SINGLE CRYSTALS BY THE FLUX METHOD. II

KOICHI WATANABE (Gumma University, Kiryu, Japan) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 114, no. 3, Nov. 1991, p. 269-278. Research supported by MOESC. refs

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The growth of YBa₂Cu₃O_{7-x} single crystals was performed by the slow cooling technique with a wide variety of fluxes such as Li-, Na-, K-carbonate, fluoride, PbO-PbF₂, Li₂O-MoO₃, BaCO₃, and BaCl₂ or with the BaO-CuO self-flux system. The desired crystals only grew from the self-flux. Plate-like crystals 5 x 5 sq mm in size and 0.2 to 0.3 mm in thickness grew from the self-flux with a small amount of BaF₂ as a dopant. The optimum growth condition is as follows: atomic ratio of Y:Ba:Cu, 1:4:12; BaF₂, 1 wt pct; soaking temperature, 1000 C, soaking time, 100 h; cooling rate, 5 C/h; cooling range, 1000-700 C. Author

A92-25430

SOLUTE TRANSPORT MECHANISM DURING LIQUID PHASE EPITAXIAL (LPE) GROWTH WITH AN APPLIED CURRENT

CHISATO TAKENAKA, TOSHIHIRO KUSUNOKI, and KAZUO NAKAJIMA (Fujitsu Laboratories, Ltd., Atsugi, Japan) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 114, no. 3, Nov. 1991, p. 293-298. refs

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The mechanism of the acceleration of solute transport is studied by passing an electric current through a solution during LPE. The amount of InP dissolved in the solution while a current was applied was measured. The current's magnitude and frequency were varied and the heater current's waveform was changed. It was found that the solute dissolved faster when the combination of the solution current and the heater coil current was either 50 Hz ac/50 Hz ac or dc/dc pulse. This indicates that the solute movement is affected by the Lorentz force generated by the current passing through the solution and the magnetic field produced in the heater coil. It is concluded that the accelerated dissolution of InP is attributed to the dynamic movement of solution by the Lorentz effect. Author

A92-25433

REAL-TIME MEASUREMENT OF LPE GROWTH RATE IN GAP

Y. INATOMI and K. KURIBAYASHI (Institute of Space and Astronautical Science, Sagami, Japan) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 114, no. 3, Nov. 1991, p. 380-388. refs

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The effect of the surface kinetics upon the dissolution and growth rates on the faceted surface during the LPE growth process in GaP has been studied by means of the real-time measurement setup, which was composed of an IR microscope with an interferometer. The measured dissolution rates agree remarkably well with the present model, in which it is assumed that solute concentration in the liquid ahead of the diffusion layer is homogenized by convection and the surface concentration is not equal to the equilibrium value. It was concluded from the values of kinetic coefficients that the rate controlling process may be the transportation of solute atoms in the liquid phase for both the dissolution process and the growth process. Author

A92-25608

THERMOCHEMICAL ETCHING EFFECT OF H₂O VAPOR ON CVD DIAMOND FILM

NOZOMU UCHIDA, TSUTOMU KURITA, HIDEKI OHKOSHI, KEIZO UEMATSU, and KATSUICHI SAITO (Nagaoka University of Technology, Japan) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 114, no. 4, Dec. 1991, p. 565-568. refs

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A92-25815

QUANTUM HOLE TRANSPORT AT THE HETEROINTERFACE OF LONG WAVELENGTH AVALANCHE PHOTODIODES

T. MIYOSHI, H. TSUCHIYA, and M. OGAWA (Kobe University, Japan) *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), vol. 28, Jan. 1992, p. 25-30. refs

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Quantum hole transport at the heterointerfaces of InGaAs-InP long wavelength avalanche photodiodes is studied using the Wigner function model. At the heterointerface, three types of quantum size structures are inserted to eliminate the photoexcited hole trapping: the thin quaternary layer, the thin graded band-gap layer, and the doping interface dipole layer. The dependence of hole accumulation on the inserted layer structure is discussed. It is shown that the theoretical reduction limits of hole pile-up can be realized even by the insertion of quantum size layers. I.E.

A92-26116

LATTICE AND ELECTRONIC STRUCTURES OF UNDOPED AND DOPED C₆₀ MOLECULES BY THE EXTENDED SU-SCHRIEFFER-HEEGER MODEL

KIKUO HARIGAYA (Electrotechnical Laboratory, Tsukuba, Japan)

Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4001-4004. refs

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Lattice and electronic structures of undoped and doped C60 are investigated. The Su-Schrieffer-Heeger model is extended and solved numerically. For the undoped system, electronic level structures agree well with those of the tight-binding model of Hayden and Mele (1987). When one or two electrons are added or removed, the lattice deforms and two levels intrude into the energy gap like a polaron in polyacetylene. The dimerization becomes weaker along a meridian. Consequences of 'polarons' for experimental studies are discussed. Author

A92-26117

ONSET OF SUPERCONDUCTIVITY IN THIN GRANULAR FILMS OF INDIUM

SATOSHI OKUMA, HAJIME KOYANAGI, and NOBUHIKO NISHIDA (Tokyo Institute of Technology, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4017-4021. refs

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The relationship is investigated between the average size of indium particles and the characteristics of superconductivity in thin granular films. It is initially assumed that the critical resistance R_c has a universal value, and the superconducting transition temperature (T_c) and R_c are measured in the films. Three series of granular indium films are prepared with arrays of particles that are nearly 2D, and the coupling strength between particles is controlled by manipulating the surface oxidation. Sheet resistance is found to vary indirectly with T_c in films with average particle sizes of 280 or 224 Å, whereas a linear relation is noted for the sheet with 140-Å particles. The system is concluded to become a dirty superconductor when the particle sizes are reduced, and for two definitions of superconductivity the value of R_c increases with the average particle size of the film. C.C.S.

A92-26118

ESR STUDY OF HALOGEN-DOPED C60

NOBUMORI KINOSHITA, YASUMOTO TANAKA, MADOKA TOKUMOTO (Electrotechnical Laboratory, Tsukuba, Japan), and SHIGEKI MATSUMIYA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4032-4035. refs

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Electron spin resonance (ESR) study of halogen-doped C60 was carried out by varying the doping conditions such as concentration and annealing time. Temperature dependence of the ESR linewidth of C60Br(x) different from that of K(x)C60 was obtained. The electronic properties of C60Br(x) and K(x)C60 were discussed. Author

A92-26119

SUPERCONDUCTIVE-CONJUGATE PHOTOCONDUCTIVITY IN HOST INSULATORS OF THE Y(3-X)-BA(X)-CU₃-O(Z) SYSTEM

TAIZO MASUMI, HIDETOSHI MINAMI, and HIROSHI SHIMADA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4036-4039. Research supported by MOESC. refs

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The spectral photoconductivity is examined for the superconductive-conjugate photoconductive-substance Y(3-x)-Ba(x)Cu₃-O(z) that demonstrates high- T_c superconductivity. Blocking electrodes are employed to measure photoconductivity by means of the transient technique using a dye laser, and the electrical resistivity is measured using the four-probe technique at higher values of x. Variations in the Ba-composition are studied, and the temperature dependence of the superconductive-conjugate photoconductivity is given with reference to the step temperatures, dark resistivity, and the corresponding spectra. The contribution of positive holes to the photoconductivity is described, and a relationship is hypothesized for superconductivity and the related photoconductivity for all values of x. It is concluded that the ground

state of the high- T_c superconductors in the Y-Ba-Cu-O system can be described as equivalent to the photoexcited state of the insulators. C.C.S.

A92-26120

NOVEL TEMPERATURE DEPENDENCE OF PHOTOCONDUCTIVITY IN NEW SEMICONDUCTOR Bi₂O₃ - M(2+)

HIDETOSHI MINAMI and TAIZO MASUMI (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4040-4043. Research supported by MOESC. refs

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Single crystals of bismuth oxide with rhombohedral layered structure have been synthesized for the first time by means of stabilization with addition of the divalent metals Sr, Ca and Cu. Novel temperature dependence of transient photoconductivity clearly indicates anomalously sustained life time of photocarriers together with magneto-resistance mobility and suggests the relaxation process due to the exciton formation with large binding energy. Similar temperature dependences have been observed also in the host insulators of high- T_c superconductors. Author

A92-26123

THE MECHANISM OF HOLE-DOPED HIGH- T_c SUPERCONDUCTIVITY

YOSHIMASA MURAYAMA (Hitachi, Ltd., Advanced Research Laboratory, Hatoyama, Japan) and SADA O NAKAJIMA (Tokai University, Hiratsuka, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4265-4279. refs

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The possibility is examined of developing a superconductive phase in parallel to the single-band model by employing the holon-doublon construct to a system based on d- and p-electrons. The algebra developed by Nakajima (1991) for treating highly correlated electrons is applied to the single-band model of the 3d₉ band of Cu in which d- and p-electrons form pairs and decrease the total energy. The basis states of the substance are described with reference to doublon operators, and the observed optical gaps are described. Comparisons are made to the analytically derived equations of motion to describe the critical temperature and the corresponding pressure effects. The d-states that are hybridized with the band called p sub sigma (+) tend to form pairs and are condensed into the superconductive ground state. The proposed model can be used to qualitatively describe the characteristic traits of hole-doped layer-structured high- T_c superconductors. C.C.S.

A92-26124

FAR-INFRARED STUDY OF BI-SR-CA-CU-O THIN FILMS ON MgO SUBSTRATES

MASAYUKI SATO, KEIGO NAGASAKA (Tokyo, Science University, Japan), MASARU IHARA, and TAKAFUMI KIMURA (Fujitsu Laboratory, Ltd., Atsugi, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4337-4350. refs

(Contract MOESC-63631003)

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FIR transmission measurements of Bi-Sr-Ca-Cu-O superconducting thin films deposited on MgO substrates have been made in the range from 50 to 300/cm at temperatures between 7 and 174 K. Transmittance spectra were fully explained by the Drude theory in the normal state. The discrepancy of a theoretical spectrum with the experimental spectrum is ascribed to a large portion of the real part of the optical conductivity below the so called energy gap approximately 400/cm. Because these extra optical conductivities are proportional to their dc conductivities in many specimens, this extra optical conductivity is ascribed to an electronic excitation due to a low-lying energy gap and/or residual normal conductivity below 400/cm. Author

A92-26125

LIGHT EMISSION CHARACTERISTICS AND SURFACE ROUGHNESS OF AU/ALO(X)/AL TUNNEL JUNCTION

YUJI HIRAO, YOSHIKI NAOI, YOSHINOBU NAGANO, and MASUO FUKUI (Tokushima University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4366-4373. refs

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Emission characteristics of light radiated from a metal-insulator-metal tunnel junction could be controlled by surface and interface roughnesses. To elucidate these situations, surface and interface roughnesses of the tunnel junction are evaluated by a lightscattering technique developed by the group. Roughness parameters obtained by such a technique are adopted to calculate the emission characteristics of light radiated from the tunnel junction, compared with experimental emission characteristics. Wavelength spectra of emission intensities are in good agreement, but angular distributions of emission intensities are not. Author

A92-26189

LATTICE-MATCHED EPITAXIAL GROWTH OF SINGLE CRYSTALLINE 3C-SIC ON 6H-SIC SUBSTRATES BY GAS SOURCE MOLECULAR BEAM EPITAXY

TATSUO YOSHINOBU, HIDEAKI MITSUI, IWAO IZUMIKAWA, TAKASHI FUYUKI, and HIROYUKI MATSUNAMI (Kyoto University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 17, 1992, p. 824-826. refs

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A92-26191

ATOMIC-SCALE MORPHOLOGY AND INTERFACES OF EPITAXIALLY EMBEDDED METAL (COAL)/SEMICONDUCTOR (GAAS/ALAS) HETEROSTRUCTURES

M. TANAKA, N. IKARASHI, H. SAKAKIBARA, K. ISHIDA, and T. NISHINAGA (Tokyo University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 17, 1992, p. 835-837. refs

(Contract MOESC-03243102)

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It is shown that both uniform CoAl films and nm-scale CoAl dots can be epitaxially embedded in GaAs/AlAs semiconductor lasers by MBE. In both cases, the metal/semiconductor interfaces are found to be extremely flat and abrupt. The morphology of embedded CoAl depends strongly on the growth temperature of the overgrown GaAs/AlAs. These kinds of materials will open new possibilities in materials science and applications to optical/electronic devices. C.D.

A92-26199

LI-DOPED BI THREE-LAYERED SUPERCONDUCTING WHISKERS

ICHIRO MATSUBARA, TORU OGURA, HIROSHI YAMASHITA, MAKOTO KINOSHITA (Government Industrial Research Institute, Ikeda, Japan), and TOMOJI KAWAI (Osaka University, Ibaraki, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 17, 1992, p. 901, 902. refs

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Bi₂Sr₂Ca₂Cu₃O₁₀ (2223) whiskers of single crystals were prepared by the conversion by annealing in powder method and the T_c was enhanced by Li doping. The results are potentially useful not only for fundamental studies of the 2223 phase but also in the field of crystal growth of metastable compounds. C.D.

A92-26512

STRUCTURAL ANALYSIS OF THE FORMATION OF CUINSE2

SHIGETAKA NOMURA (Nihon University, Tokyo, Japan), HIROAKI MATSUSHITA (Tokyo Science University, Japan), and TAKEO TAKIZAWA (Nihon University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3461-3464. refs

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The mechanism of the phase change from Cu(2-x)Se to CuInSe₂ by the absorption of indium selenide is analyzed in terms of the simulation of X-ray diffraction. The crystal structure of Cu(2-x)Se is proposed on the basis of zinc-blende structure. The simulated

X-ray diffraction patterns indicate that more than half of the anion sites are randomly occupied by selenium atoms with the cation sites being fully occupied by copper atoms in the crystal structure of Cu(2-x)Se which is regarded as a frame structure of CuInSe.

Author

A92-26531

EVALUATION OF THE SURFACE STRUCTURE OF DIAMOND FILMS PREPARED IN A COMBUSTION FLAME BY SURFACE-ENHANCED RAMAN SCATTERING

KATSUYUKI OKADA, SHOJIRO KOMATSU, TAKAMASA ISHIGAKI, SEIICHIRO MATSUMOTO, and YUSUKE MORIYOSHI (National Institute for Research in Inorganic Materials, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 24, 1992, p. 959-961. refs

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Surface-enhanced Raman scattering was performed on the surface characterization of polycrystalline diamond films prepared in a C₂H₂-O₂ combustion flame. The conventional Raman spectra of a diamond film showed only the peak at 1333/cm corresponding to diamond. However, if Ag island films were coated onto the diamond surface (Ag overlayer method), the resultant spectra changed drastically. The peaks around 1580 and 1355/cm were remarkably enhanced; the former is assigned to the sp² graphite structure and the latter is assigned to the disordered microcrystalline graphite structure, respectively. This would indicate that the diamond surface has a sp²-like structure, which is different from the sp³ structure in bulk. This surface configuration is discussed from the viewpoint of the surface reconstruction.

Author

A92-26533

MOLECULAR LAYER ETCHING OF GAAS

YOSHINOBU AOYAGI (Osaka University, Toyonaka; Institute of Physical and Chemical Research, Wako, Japan), KOJI SHINMURA, KIYOSHI KAWASAKI, TOMOKO TANAKA, KENJI GAMO, SUSUMU NAMBA (Osaka University, Toyonaka, Japan), and ICHIROU NAKAMOTO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, Feb. 24, 1992, p. 968-970. refs

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Layer-by-layer controlled molecular layer self-limiting etching at one molecular layer of GaAs was successfully achieved for the first time by alternatively feeding an etchant of Cl and applying a low energy Ar ion beam to the GaAs substrate. The etching rate saturates exactly at one molecular layer per cycle and is independent of etchant feeding rate and the energetic ion beam flux.

Author

A92-26547

CRYSTALLINE INSE FILMS PREPARED BY RF-SPUTTERING TECHNIQUE

SHIGERU SHIGETOMI (Kurume University, Japan) and TESUO IKARI (Miyazaki University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 30, Dec. 15, 1991, p. L2127-L2129. refs

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The X-ray diffraction, optical absorption and Raman spectra of RF-sputtered InSe films are measured as a function of annealing temperature. The films annealed at 400 C have a crystalline structure and the c-axis in the rhombohedral phase is oriented perpendicular to the substrate plane. The optical properties in crystalline films follow the same mechanism as that of the InSe single crystal.

Author

A92-26862

SYNTHESIS OF TI-BASED '2234' SUPERCONDUCTORS

TETSUYUKI KANEKO, KAZUYUKI HAMADA, SEIJI ADACHI, H. YAMAUCHI, and SHOJI TANAKA (International Superconductivity Technology Center, Tokyo, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, March 1, 1992, p. 2347-2350. Research supported by New Energy and Industrial Technology Development

Organization of Japan. refs
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Results of a synthesis of nearly single-phase samples of superconducting Ti-Ba-Ca-Cu-O '2234' are presented. Consideration was given to the fact that, since the 2234 phase had per unit cell two Cu ions which had a coordination number of four, the Cu ions in the low oxidation were stable at low-oxygen partial pressures. The sample sintered in air had T_c of 112 K. Post-annealing of the sintered sample in a high-pressure oxygen gas made its T_c increase up to 115 K. The sample sintered in argon gas had T_c of 90 K. The thermoelectric power (TEP) of the sample was also measured. All the samples showed positive TEP signals. The magnitude of the TEP signal decreased as T_c increased. It is argued that the as-sintered 2234 phase was in an underdoped state with respect to the optimum carrier concentration. P.D.

A92-28424* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

NUCLEATION MECHANISMS FOR COMPOUND SEMICONDUCTORS GROWN ON SI BY MOCVD

TETSUO SOGA (Nagoya Institute of Technology, Japan), THOMAS GEORGE (JPL, Pasadena, CA), TAKASHI JIMBO, and MASAYOSHI UMENO (Nagoya Institute of Technology, Japan) (International Organization of Crystal Growth, Japan Society of Applied Physics, Japanese Association of Crystal Growth, et al., International Conference on Vapour Growth and Epitaxy, 7th, Nagoya, Japan, July 14-17, 1991) Journal of Crystal Growth (ISSN 0022-0248), vol. 115, no. 1-4, Dec. 1991, p. 418-422. refs
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The influence of growth parameters on the initial stage of heteroepitaxial growth of GaP, GaAs and AlAs on (100) Si substrates was examined. GaP and GaAs grow on Si in three-dimensional growth mode, forming well separated islands. However, such islands were observed to be contiguous in the case of AlAs growth on Si. The island density was seen to be proportional to the growth rate. GaAs and GaP exhibit very different growth behavior with increasing V/III flux ratio. Misorientation of the Si substrate does not appear to affect the island densities. Possible mechanisms for this growth behavior, based on cluster formation and migration, are discussed for the growth of these compound semiconductors on Si. Author

A92-28425

FORMATION OF TIN BY NITRIDATION OF MAGNETRON SPUTTERED TI FILMS USING MICROWAVE PLASMA CVD

JONG MOON, TOSHIMICHI ITO, JING S. MA, and AKIO HIRAKI (Osaka University, Suita, Japan) (International Conference on Vapour Growth and Epitaxy, 7th, Nagoya, Japan, July 14-17, 1991) Journal of Crystal Growth (ISSN 0022-0248), vol. 115, no. 1-4, Dec. 1991, p. 589-595. refs
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The formation of a $\text{TiN}(z)/\text{TiSi}(x)$ bilayer is studied based on microwave-assisted nitrogen plasma nitridation of titanium film with changing microwave power. Rutherford backscattering spectrometry, X-ray photoelectron spectroscopy, X-ray diffractometry, and transmission electron microscopy are used to characterize the formation of the $\text{TiN}(z)/\text{TiSi}(x)$ bilayer and to examine the barrier properties. The results show that the nitrided and silicided Ti layers grow in thickness and increase in concentration according to microwave power increase and that the samples treated above the power of 200 W have good film properties, and that the $\text{TiN}(z)/\text{TiSi}(x)/\text{Si}$ structure has good diffusion barrier properties up to about 500 C for 30-min heat treatment. Author

A92-28892

ELECTRICAL ANISOTROPY IN BI-SR-CA-CU-O THIN FILMS PREPARED ON 110-PLANE SrTiO_3 BY METALORGANIC CHEMICAL VAPOR DEPOSITION

TSUNEMI SUGIMOTO, NOBUHIKO KUBOTA, YUH SHIOHARA, and SHOJI TANAKA (Superconductivity Research Laboratory, Tokyo, Japan) Applied Physics Letters (ISSN 0003-6851), vol.

60, March 16, 1992, p. 1387-1389. Research supported by New Energy Development Organization of Japan. refs
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Highly 119-plane oriented Bi-Sr-Ca-Cu-O thin films with the transition temperature as high as 70 K on 110-plane and 5 deg off 110-plane SrTiO_3 substrates were prepared by metalorganic chemical vapor deposition. The normal state resistivity along the 1 -1 0 line direction (tilted about 45 deg to the a-b plane of the film) was 200 times larger than that measured along the 001-line direction (parallel to the a-b plane of the film) for the film prepared on a 5-deg off-oriented 110-plane SrTiO_3 substrate. The anomalous drop of the resistivity near the $T_{sub c 0}$ was observed in the film prepared on a 110-plane SrTiO_3 substrate. Author

A92-29403

SPONTANEOUS GROWTH OF WHISKERS FROM AN INTERLAYER OF Mo_2C BENEATH A DIAMOND PARTICLE DEPOSITED IN A COMBUSTION-FLAME

KATSUYUKI OKADA, SHOJIRO KOMATSU, TAKAMASA ISHIGAKI, SEIICHIRO MATSUMOTO, and YUSUKE MORIYOSHI (National Institute for Research in Inorganic Materials, Tsukuba, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 116, no. 3-4, Feb. 1992, p. 307-313. refs
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The growth mechanism of whiskers from an interlayer of Mo_2C beneath a diamond particle deposited in a combustion flame is discussed from two different points of view. The reduction of the surface free energy by the surface oxidation supplies the driving force of the whisker growth in the direction of the Burgers vector of screw dislocations. The internal stress, which is caused by the difference of the thermal expansion between a diamond and an interlayer of Mo_2C on a molybdenum substrate, provides the driving force for the growth of the whisker beneath the diamond. P.D.

A92-29512

FREQUENCY-DEPENDENT CONDUCTIVITY IN POLYCRYSTALLINE CHEMICAL VAPOR DEPOSITED DIAMOND FILMS

YASUAKI MUTO, TAKASHI SUGINO (Osaka University, Suita, Japan), KOJI KOBASHI (Kobe Steel, Ltd., Electronics Research Laboratory, Japan), and JUNJI SHIRAFUJI (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Jan. 15, 1992, p. L4-L6. refs
Copyright

Studies have been made on frequency-dependent electrical conduction in polycrystalline diamond films prepared by plasma-enhanced chemical vapor deposition (PECVD). It is found by ac conductivity measurements that the electrical conduction in annealed diamond films is attributed to frequency-independent band conduction in a low-frequency range, ($f \exp 0.8$)-dependent hopping conduction in a high-frequency range and thermal emission of carriers from trap levels. Activation energies of three trap levels are 0.62, 1.38, and 0.95 eV. The 0.62 and the 1.38 eV trap levels are passivated in hydrogenated diamond films. Author

A92-29513

MECHANICAL PROPERTIES OF BI-BASED SUPERCONDUCTING WHISKERS

ICHIRO MATSUBARA (Government Industrial Research Institute, Ikeda, Japan), YOSHIHIRO HASHIMOTO, KUNIO ATAGO (Osaka Electro-Communication University, Neyagawa, Japan), HIROSHI YAMASHITA, MAKOTO KINOSHITA (Government Industrial Research Institute, Ikeda, Japan), and TOMOJI KAWAI (Osaka University, Ibaraki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Jan. 15, 1992, p. L14-L16. refs
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Mechanical properties of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(x)$ whiskers which are composed of several platelike single crystals stacked in a layered structure have been examined. Tensile strength, which is assumed to be an intrinsic strength of the compound, has been measured by pulling the whiskers in the direction of alpha-axis corresponding

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to the whisker axis. The maximum tensile strength and elastic modulus determined from the stress-strain curve are 940 MPa and 92 GPa, respectively. Author

A92-29514

HIGH-RESOLUTION ELECTRON MICROSCOPY OF RADIATION DAMAGE OF YBA₂CU₄O(Y) SUPERCONDUCTOR INDUCED BY 200 KV ELECTRON BEAM

YOSHIO MATSUI (National Institute for Research in Inorganic Materials, Tsukuba, Japan) and KASUMI YANAGISAWA (Kobe Steel, Ltd., Chemical Technology Laboratory, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Jan. 15, 1992, p. L29-L32. refs
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A92-29515

DIRECT OBSERVATION OF OXYGEN ATOMS IN A TETRAGONAL YBA₂CU₃O(7.7) HIGH-TC SUPERCONDUCTOR BY MEANS OF ULTRA-HIGH-RESOLUTION HIGH VOLTAGE ELECTRON MICROSCOPY

SHIGEO HORIUCHI, YOSHIO MATSUI (National Institute for Research in Inorganic Materials, Tsukuba, Japan), and BIN OKAI (Kogakuin University, Tokyo, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Jan. 15, 1992, p. L59-L62. refs
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A92-30418

ANISOTROPY IN A HEAVY FERMION SUPERCONDUCTOR - UPD₂Al₃

NORIAKI SATO, TAKUO SAKON, NAOYA TAKEDA, TAKEMI KOMATSUBARA (Tohoku University, Sendai, Japan), CHRISTOPH GEIBEL, and FRANK STEGLICH (Darmstadt, Technische Hochschule, Federal Republic of Germany) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, Jan. 1992, p. 32-34. Research supported by European-Japanese Joint Project on Heavy Fermions and MOESC. refs
Copyright

The paper reports on the anisotropy of magnetization, electrical resistivity and upper critical magnetic fields ($H(c_2)$) of UPd₂Al₃. The magnetization curve in the antiferromagnetically ordered state shows large anisotropy, indicating that the sublattice moments lie in the basal hexagonal plane. The value of $-(dH(c_2)/dT)$ at T_c is estimated to be about 36 (kOe/K) for the magnetic field parallel and perpendicular to the hexagonal c-axis, and the upper critical field seems to be rather isotropic. Author

A92-31447

SUPERCONDUCTING PROPERTIES AND NORMAL-STATE RESISTIVITY OF SINGLE-CRYSTAL NBN FILMS PREPARED BY A REACTIVE RF-MAGNETRON SPUTTERING METHOD

A. SHOJI, S. KIRYU, and S. KOHJIRO (Electrotechnical Laboratory, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, March 30, 1992, p. 1624-1626. refs
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Some superconducting properties and normal-state resistivities of single-crystal NbN films prepared by a reactive RF-magnetron sputtering method are reported. It is found that the prepared single-crystal NbN films have T_c 's above 16 K, normal-state resistivities in the range from 12.2 to 14.3 microhms cm (at 20 K), and magnetic penetration depths in the range from 93 to 100 nm (at 4.2 K). From a temperature dependence of the upper critical magnetic field for a single-crystal NbN film, the zero-temperature Ginzburg-Landau coherence length for the film was calculated to be 6.9 nm. Author

A92-32351

EFFECT OF OXYGEN PLASMA ON GROWTH OF Y-BA-CU-O FILMS BY REACTIVE MAGNETRON SPUTTERING

MASAYUKI SAGOI, YOSHIAKI TERASHIMA, and TADAO MIURA (Toshiba Corp., Advanced Research Laboratory, Kawasaki, Japan) IN: Superconductivity and ceramic superconductors II; Proceedings of the Symposium, Orlando, FL, Nov. 12-15, 1990.

Westerville, OH, American Ceramic Society, Inc., 1991, p. 461-468. refs

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Y-Ba-Cu-O films were prepared using a reactive magnetron sputtering method with three targets. The influence of the sputtering conditions on the growth and oxidation of the films were examined. The sputtering pressure, the distance between the substrate and targets, oxygen content in the sputtering gas, and the substrate temperature were very influential on the properties of the films.

Author

A92-32378

PREPARATION AND CHARACTERIZATION OF WIDE AREA, HIGH QUALITY DIAMOND FILM USING MAGNETOACTIVE PLASMA CHEMICAL VAPOUR DEPOSITION

AKIO HIRAKI, HIROSHI KAWARADA, JIN WEI, and JUN-ICHI SUZUKI (Osaka University, Suita, Japan) IN: Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 10-21. refs

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A magnetomicrowave plasma was used for the low pressure deposition of diamond. The important point in the plasma deposition system is to set the electron cyclotron resonance (ECR) condition (875 G in the case of a 2.45 GHz microwave) at the deposition area. The high density plasma (above 1×10^{11} /cu cm) necessary for high quality diamond formation was obtained by effective microwave absorption near the magnetic field, satisfying the ECR condition. The plasma is uniform at the discharge area (160 mm in diameter) and uniform diamond films of a high quality are obtained. From an investigation of diamond formation in the range 50-100 Torr in the same deposition system, it is obvious that the lower pressure reduces the formation temperature of diamond to 500 C and that the effective species for diamond formation are low energy radicals. Author

A92-32379

AN EXPERIMENT IN LARGE AREA DIAMOND COATING USING A COMBUSTION FLAME TORCH IN ITS TRAVERSING MODE

M. MURAKAWA, S. TAKEUCHI, and Y. HIROSE (Nippon Institute of Technology, Saitama, Japan) IN: Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 22-29. Research supported by Showa Denko. refs

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This paper deals with an experiment in which a large area substrate is diamond coated using a combustion method. A tungsten substrate (50 x 50 x 5 mm) was used, over which an oxyacetylene combustion flame was passed at a speed of 2 mm/min to obtain a diamond coating. By establishing an optimum combination of coating parameters, including gas flow rate and substrate cooling rate, the substrate could be completely coated with a good diamond film over an area of approximately 40 x 40 mm. Author

A92-32380

THE IMPROVEMENT OF THE ADHESION STRENGTH OF DIAMOND FILMS

KOSUKE SAJO, MASARU YAGI, KUNIO SHIBUKI, and SOKICHI TAKATSU (Toshiba Tungaloy Co., Ltd., Kawasaki, Japan) IN: Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 30-40. refs

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The effect of surface decarburization of a tungsten carbide

(WC) substrate on the adhesion strength of diamond films is investigated. Surface decarburization and diamond coating were carried out using a microwave plasma chemical vapor deposition apparatus. Good adhesion was obtained by surface decarburization of the substrate before diamond coating. From the results of observations by SEM and TEM, the improvement in the adhesion strength is argued to be due to an increase in the contact area between the film and the substrate by the generation of fine WC grains on the surface of the substrate, with the film embedded in the shape of a wedge at the fine WC grain boundaries. The coated insert demonstrates a very small steady wear without film flaking when milling a hard carbon compared with the large amount of wear exhibited by uncoated cemented carbides. P.D.

A92-32381

DIAMOND CRYSTAL GROWTH ON SILICON AND ITS INTERFACIAL CHARACTERIZATION

SHIRO KARASAWA, KEN KOBAYASHI, TAKESHI WATANABE (Kanagawa Prefecture, Industrial Research Institute, Yokohama, Japan), and FUMITAKA TOGASHI (Tokyo, Science University, Japan) IN: Metallurgical coatings and thin films 1990; Proceedings of the 17th International Conference on Metallurgical Coatings and 8th International Conference on Thin Films, San Diego, CA, Apr. 2-6, 1990. Vol. 1. London and New York, Elsevier Applied Science, 1990, p. 41-52. refs

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Diamond thin films were grown on (111)Si substrates using electron-assisted chemical vapor deposition (EACVD) with gas fed by the natural circulation of thermal convection. High-resolution TEM (HRTEM) micrographs were successfully obtained in the vicinity of the interface of the diamond films. Lattice images of diamond as well as of silicon were simultaneously obtained. A buffer layer approximately 2 nm thick was observed between the diamond film and the silicon substrate. From nanometer-scale-area electron diffraction using a 2-nm beam probe, the buffer layer was confirmed to be an amorphous layer: the HRTEM image of the diamond film was the 110 plane of the diamond structure in the vicinity of the interface, and that of silicon was the -2 1 1 plane. Optical diffraction from the interface showed that the diamond film was preferentially oriented in the -1 1 -1 line direction. The HRTEM lattice image of the interface was in good agreement with a geometric atomic schematic projection to the 110 plane of the diamond structure. P.D.

A92-32426

EFFECT OF ANNEALING AND SULFUR PASSIVATION OF GAAS SURFACE IN ZNSE/GAAS HETEROSTRUCTURE

PRAKASH A. MURAWALA (Samco International, Inc., Research and Development Div., Takeda; Kyoto University, Japan), OSAMU TSUJI (Samco International, Inc., Research and Development Div., Takeda, Japan), SHIZUO FUJITA, and SHIGEO FUJITA (Kyoto University, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3777-3781. Research supported by Hoso Bunka Foundation and Nissha Aid for Academic Research. refs

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Consideration is given to the effect of annealing and sulfur (S) passivation of GaAs surface on the interface characteristics and interdiffusion problem in ZnSe/GaAs heterostructures whose ZnSe layers are grown by atomic layer epitaxy and metalorganic molecular beam epitaxy. The photoluminescence intensity of self-activated centers created due to interdiffusion at 500 C in the conventionally grown sample is 3-14 times higher than that in the S-passivated sample. Secondary ion mass spectroscopy data suggest that after annealing, Ga and As concentration in the ZnSe epilayer is lower in S-passivated materials. These features suggest that heterostructures are thermally stable in S-passivated material. As a result of S-passivation, full width at half maximum values of X-ray rocking curves are greatly reduced and well-defined C-V characteristics are achieved for a metal/pseudoinulating ZnSe/GaAs metal-insulator-semiconductor diode without

postgrowth annealing. Sulfur passivation is an important tool for the fabrication of high-quality heterostructures of II-VI and III-V semiconductors. Author

A92-32427

PREPARATION OF PBTIO3 THIN FILMS BY ION- AND PHOTOASSISTED EVAPORATION

SHIGENORI HAYASHI, KENJI IJIMA, and TAKASHI HIRAO (Matsushita Electric Industrial Co., Ltd., Central Research Laboratories, Moriguchi, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3806-3809. Research supported by New Energy and Industrial Technology Development Organization of Japan. refs

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PbTiO₃ films were grown on MgO substrates by the recently developed ion- and photoassisted evaporation technique. Pb and Ti were evaporated from electron-beam-heated metal sources under the irradiation of an oxygen ion beam and excimer laser beam for the ion activation and for the photoactivation, respectively. Crystal structure of the films was significantly affected by ion energy, ion current, laser pulse energy and repetition rate. The substrate temperature required for in situ preparation of perovskite PbTiO₃ could be lowered to 450 C by ion-assisted evaporation and to room temperature by ion- and photoassisted evaporation. Author

A92-32429

PREPARATION AND PROPERTIES OF ULTRATHIN HIGH-TC SUPERCONDUCTING FILMS ON SI

HIROAKI MYOREN (Hiroshima University, Higashi-Hiroshima, Japan), KANJI HARADA (Tsuyama National College of Technology, Japan), AIKO MIYAMOTO, NAOKAZU MIYAMOTO, and YUKIO OSAKA (Hiroshima University, Higashi-Hiroshima, Japan) (Japan Society of Applied Physics, International Conference on Solid State Devices and Materials, Yokohama, Japan, Aug. 27-29, 1991) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 30, Dec. 1991, p. 3896-3899. Research supported by MOESC. refs

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Ultrathin Ba₂YCu₃O_x films with thickness down to 7 nm were grown epitaxially on a Si(100) substrate using buffer layers (Y₂O₃(10 nm) and YSZ(40 nm)). These films show metallic behavior and full superconductivity through revealing broadened transitions. The critical current densities at 40 K are about 5 x 10 exp 6 A/sq cm and 5 x 10 exp 5 A/sq cm for 100 nm- and 28 nm-thick films, respectively. Author

A92-32435

INDIUM ANTIMONIDE LAYER GROWN ON SEMI-INSULATING GAAS BY LOW-PRESSURE METALORGANIC CHEMICAL VAPOR DEPOSITION

YASUO IWAMURA and NAOZO WATANABE (Kanagawa University, Yokohama, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Feb. 1, 1992, p. L68-L70. Research supported by Sony Corp. refs

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An indium antimonide single crystal is epitaxially grown on a semiinsulating GaAs. Layer thickness is changed from 0.15 to 4.2 microns. The X-ray diffraction peak (400) position does not change much with thickness, while its width decreases with increasing thickness. Crystal orientation is (100) from the early stage, and its crystallinity improves with thickness. The 300 K mobility increases from 940 to 25,000 sq cm/V s and carrier concentration decreases from 1.1 x 10 exp 18 to 8.0 x 10 exp 16/cu cm with thickness. Their dependence on thickness and temperature indicates that lattice scattering, ionized impurity scattering and defect-related scattering all contribute to limiting the mobility. Author

A92-32436

CRYSTAL STRUCTURE OF THE HIGH-TC PHASE (TC IS APPROXIMATELY EQUAL TO 111 K) IN THE SB-PB-BI-SR-CA-CU-O SYSTEM

NAOTO KIJIMA (Mitsubishi Kasei Corp., Yokohama, Japan) and RONALD GRONSKY (Lawrence Berkeley Laboratory, Berkeley, CA) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Feb. 1, 1992, p. L82-L85. refs (Contract DE-AC03-76SF-00098)

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The crystal structure of the high-T_c phase (about 111 K) in the Sb-Pb-Bi-Sr-Ca-Cu-O system has been determined using TEM. Both EDXS and high-resolution TEM indicate that Sb partially substitutes for Ca in the high-T_c phase (about 111 K) of the Sb-Pb-Bi-Sr-Ca-Cu-O system, accompanied by extra oxygen atoms that compensate the oxygen deficiency in the central Cu-O layer sandwiched between adjacent Ca/Sb layers. Author

A92-32438

SPACE GROUP DETERMINATION OF DECAGONAL QUASICRYSTALS OF AN AL70NI15FE15 ALLOY USING CONVERGENT-BEAM ELECTRON DIFFRACTION

MASAKAZU SAITO, MICHIOYOSHI TANAKA, AN P. TSAI, AKIHISA INOUE, and TSUYOSHI MASUMOTO (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, Feb. 1, 1992, p. L109-L112. Research supported by MOESC. refs

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A92-33167

AS-GROWN PREPARATION OF HIGH-CRITICAL-TEMPERATURE SUPERCONDUCTING Y1BA2CU3O(7-X) FILMS BY RADIO-FREQUENCY PLASMA FLASH EVAPORATION

KAZUO TERASHIMA, TATSUYA AKAGI, HISASHI KOMAKI, and TOYONOBU YOSHIDA (Tokyo, University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, April 1, 1992, p. 3427-3430. Research supported by Science and Technology Agency. refs

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As-grown superconducting Y1Ba2Cu3O(7-x) films were successfully synthesized on (100) MgO and (100) SrTiO3 substrates by RF plasma flash evaporation, in which fine powder mixtures of constituents are continuously injected into an RF plasma, co-evaporated, and codeposited onto a substrate. In particular, films deposited on a (100) SrTiO3 substrate at 670 C exhibited a superconducting transition temperature of 92 K and critical current density of 300,000 A/sq cm under zero magnetic field at 77 K. The excitation temperatures of several species during the depositions were estimated from optical emission spectroscopy. The temperature of Y(+) was a few thousand degrees lower than that of Ba(+) and Cu. The difference in these excitation temperatures revealed that this plasma process was a nonequilibrium deposition. Author

A92-33477

FLUX CREEP IN THE MELT-PROCESSED BI-BASED OXIDE SUPERCONDUCTORS INCLUDING NORMAL PARTICLES

TOSHIO UMEMURA, KUNIHICO EGAWA, SHIN-ICHI KINOUCHI, JUNJI TANIMURA, AYUMI NOZAKI, and SHIN UTSUNOMIYA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Sagami-hara, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, March 15, 1992, p. 2765-2768. refs

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The Bi-based 2212 plane single grains including a large number of normal particles, (Ca,Sr)2Cu1O3, were synthesized by a melt process. To characterize the flux-creep behavior in such a superconductor, magnetization measurements were performed at various temperatures and magnetic fields. The flux-creep rate exhibited a maximum at 20 K in both magnetic fields parallel and normal to the c axis. The magnetic-field-dependence of the pinning potential evaluated from the residual magnetization was not

represented by the expression $B \exp -\alpha$ in Y1Ba2Cu3O7 superconductors. Author

A92-33482

FABRICATION OF HIGHLY ORIENTED YBA2CU4O8 FILMS BY ALKOXIDE SOL-GEL METHODS

SHINGO KATAYAMA, MASAHIRO SEKINE (Colloid Research Institute, Kitakyushu, Japan), HIROSHI FUDOUZI, and MAKOTO KUWABARA (Kyushu Institute of Technology, Kitakyushu, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, March 15, 1992, p. 2795-2798. Research supported by Japan Key Technology Center. refs

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YBa2Cu4O8 films were fabricated on MgO 100 plane single-crystal and Ag substrates at atmospheric pressure by the sol-gel method using metal alkoxides. On MgO 100 plane substrates, YBa2Cu4O8 films were formed at 800 C through YBa2Cu3O(7-x). On Ag substrates, YBa2Cu4O8 films were obtained at a firing temperature as low as 700 C and highly oriented films were formed at 800 C. YBa2Cu4O8 films were not formed through YBa2Cu3O(7-x) in this case. Simultaneous use of the sol-gel method and Ag substrates was remarkably effective for promoting the formation of the YBa2Cu4O8 phase and producing highly oriented films. Author

A92-33823

SUPERCONDUCTING AND OPTICAL PROPERTIES OF ULTRATHIN FILMS OF Bi2(SR,CA)3CU2O(X) FORMED AT 673 K

AKIHISA YANASE (Institute of Physical and Chemical Research, Wako, Japan), MASAMI MORI, ZIYUAN LIU, and MAKI KAWAI (Tokyo Institute of Technology, Yokohama, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, April 20, 1992, p. 2020-2022. Research supported by MOESC. refs

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Electronic properties of ultrathin films of Bi2(Sr,Ca)3Cu2O(x), successively formed on MgO(100) at a substrate temperature of 673 K using atomic layering deposition of metals followed by oxidation with a 8×10^{-7} Torr NO2 are studied. It was revealed that the film formed at 673 K showed a semiconductive property, whereas the film annealed at 1093 K with 760 Torr O2 shows a superconducting transition with the onset T_c of 90 K and the zero-resistance T_c of 40 K. Optical absorption and X-ray diffraction studies indicate that the electronic structure of Bi2(Sr,Ca)3Cu2O(x) ultrathin film changes from charge-transfer type semiconductor to a superconductor with an in-gap band, due to the increase in carrier concentration caused by annealing with O2. Author

A92-33890

GRAIN-BOUNDARY INTERFACIAL STATES IN BEO-DOPED SIC CERAMICS - PHOTOISOTHERMAL CAPACITANCE TRANSIENT SPECTROSCOPY

SHIGERU TANAKA, KEN TAKAHASHI (Hitachi, Ltd., Japan), CHIYOSHI AKITA (Taiyo Yuden Co., Ltd., Haruna, Japan), HIDEYO OKUSHI (Electrotechnical Laboratory, Tsukuba, Japan), YOSHIKI WADA, and JUNZO TANAKA (National Institute for Research in Inorganic Materials, Tsukuba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, April 15, 1992, p. 3836-3841. Research supported by Science and Technology Agency of Japan. refs

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A92-33892

POLYMERIZED COMPLEX SYNTHESIS AND INTERGRANULAR COUPLING OF BI-PB-SR-CA-CU-O SUPERCONDUCTORS

CHARACTERIZED BY COMPLEX MAGNETIC SUSCEPTIBILITY MASATO KAKIHANA, MASAHIRO YOSHIMURA (Tokyo Institute of Technology, Yokohama, Japan), HIROMASA MAZAKI, HIROSHI YASUOKA (National Defense Academy, Yokosuka, Japan), and LARS BORJESSON (Chalmers University of Technology, Goteborg, Sweden) Journal of Applied Physics (ISSN 0021-8979), vol. 71, April 15, 1992, p. 3904-3910. Research supported by Swedish

National Science Research Council and STU. refs
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A92-33895

ANOMALOUS REFRACTIVE INDEX CHANGE AND RECOVERY OF ELECTRO-OPTIC COEFFICIENT R33 IN PROTON-EXCHANGED LTAO3 OPTICAL WAVEGUIDES AFTER ANNEALING

TOSHIYA YUHARA, KUNIO TADA, and YU-SHAN LI (Tokyo, University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, April 15, 1992, p. 3966-3974. refs
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A92-33896

ANALYSIS OF DIAMOND PHASE IN HYDROGENATED HARD CARBON FILM USING RADIO FREQUENCY PLASMA ETCHING

YOSHIHITO SHIMADA, NOBUKI MUTSUKURA, and YOSHIO MACHI (Tokyo Denki University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, April 15, 1992, p. 4019-4024. refs
Copyright

The hydrogenated hard carbon films prepared in CH₄ radio frequency (RF) discharge, have been examined to characterize the film structure by means of several spectroscopic measurements combined with CF₄ RF plasma etching. The CF₄ plasma etching can selectively remove the amorphous phase with graphite structure, and can retain the diamond structure in the film. After the CF₄ plasma etching for a long time, cylindrical structures and/or particles were formed on the substrate. The top of the cylindrical structure or the particle was diamond, and the bottom part was the Si substrate. It was confirmed that most of the components in the hard carbon film is amorphous phase, and the diamond phases exist at the interface between the film and the substrate. Author

A92-34061

LONG-RANGE SELF-ORGANIZATION OF PSEUDO-1D NIAL SINGLE-CRYSTAL ARRAY

K. KAMIGAKI, M. ISHIDA, M. NIBOSHI, H. TERAUCHI, and N. SANO (Kwansei-Gakuin University, Nishinomiya, Japan) Physical Review Letters (ISSN 0031-9007), vol. 68, April 13, 1992, p. 2317-2320. Research supported by MOESC. refs
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A long-range self-organization of a pseudo-1D single-crystal island array in a early epitaxial-growth stage of NiAl on (001) AlAs at 790 K is shown. Up to the coverage $\Theta = 0.4$, the dominant growth feature is an elongation along the 1-1 0 line(AlAs) direction with constant island height. As a result, there appears a quasi-periodic array of NiAl wires over a few microns long running along the 110-line(AlAs) direction at $\Theta = 0.4$. After that, the dominant growth behavior changes from the lateral growth to a growth in height. Author

A92-34149

MECHANISM OF CRYSTAL GROWTH OF LITHIUM ALUMINATE PARTICLES IN MOLTEN LITHIUM AND POTASSIUM CARBONATES

H. SOTOUCHI, Y. WATANABE, T. KOBAYASHI, and M. MURAI (Tokyo Electric Power Co., Inc., Engineering Research Center, Chofu, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, April 1992, p. 1127-1130. refs
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The growth of particles of lithium aluminate in the electrolyte matrix of molten carbonate fuel cells is problematic in that the particles agglomerate in the electrolyte with the passage of time, thereby decreasing retention of the alkali carbonate melt. To further elucidate the growth mechanism of lithium aluminate particles, the effects of temperature, P(CO₂) and Li/K ratio in the melt on particle growth were determined. Equilibrium solubility measurements of lithium aluminate in a molten carbonate were also performed under various conditions. The results indicated that particle growth depends on the basicity of the electrolyte. Author

A92-35499

SUPERCONDUCTIVITY IN SODIUM- AND LITHIUM-CONTAINING ALKALI-METAL FULLERIDES

K. TANIGAKI, I. HIROSAWA, T. W. EBBESEN, J. MIZUKI, Y. SHIMAKAWA, Y. KUBO, J. S. TSAI, and S. KUROSHIMA (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan) Nature (ISSN 0028-0836), vol. 356, no. 6368, April 2, 1992, p. 419-421. refs
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The monotonic relationship between T_c and lattice constant a₀ in face-centered M3C60 compounds is studied over a wider range than previously done, using mixed alkali compounds incorporating sodium and lithium. The Na₂MC60 compounds have face-centered cubic structures and are superconducting, with T_c = 12 K (M = Cs), 2.5 K (M = Rb), and 2.5 K (M = K); these T_cs are lower than those predicted on the basis of high-pressure studies. This departure from the previous relationship between T_c and a₀ for lattice parameters smaller than that of pristine C60 may provide new insights into what controls superconductivity in these materials. C.D.

A92-35891

COMPOSITIONAL EFFECTS ON IN SITU YBACUO FILMS GROWN AT LOW OXYGEN PRESSURES

KAZUHIKO SHINOHARA, FUMIO MUNAKATA, MITSUGU YAMANAKA (Nissan Motor Co., Ltd., Scientific Research Laboratory, Yokosuka, Japan), VLADIMIR MATIJASEVIC (Delft University of Technology, Netherlands), PETER ROSENTHAL, ROBERT HAMMOND, and MALCOLM R. BEASLEY (Stanford University, CA) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L160-L162. refs
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YBaCuO films were grown by reactive coevaporation at various oxygen pressures and compositions. The T_c values for these films were strongly affected by composition, especially by the Ba/Y ratio. The composition ratios of Ba/Y optimized for T_c above 85 K were found to decrease with decreasing oxygen pressure during growth. Author

A92-35893

CHARGE TRANSPORT AND SUPERCONDUCTING TRANSITIONS IN C60 SINGLE CRYSTALS AND THIN FILMS DOPED WITH RUBIDIUM

HIRONORI OGATA, TAMOTSU INABE, HAJIME HOSHI, YUSEI MARUYAMA (Graduate University for Advanced Studies, Okazaki, Japan), YOHJI ACHIBA, SHINZO SUZUKI, KOICHI KIKUCHI, and ISAO IKEMOTO (Tokyo Metropolitan University, Hachioji, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L166-L168. refs
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Superconductivity is confirmed in rubidium-doped C60 samples prepared from single crystals and thin films, by electrical resistivity measurements. Superconducting transition temperatures (T_c) are observed at T_c(onset) = 30 K, T_c(offset) = 26 K, and T_c(onset) = 22 K, and T_c(offset) = 2.5 K, respectively. The details of the doping conditions are described. Author

A92-35894

EFFECT OF SIZE OF SUPERCONDUCTOR ON ESTIMATION OF CRITICAL CURRENT DENSITY USING AC INDUCTIVE METHOD

NOZOMU OHTANI, EDMUND S. OTABE, TERUO MATSUSHITA (Kyushu Institute of Technology, Iizuka, Japan), and BAORONG NI (Kyushu University, Fukuoka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L169-L171. Research supported by MOESC. refs
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Applicability of the ac inductive method for estimation of the critical current density, J_c, in superconductors of relatively small size is theoretically investigated in terms of the Campbell model for pinning force density vs the displacement of fluxoids. It is shown that J_c is significantly overestimated by the conventional

method due to reversible fluxoid motion for superconductors comparable to or smaller than Campbell's ac penetration depth, λ -prime sub 0. Only the recently proposed analysis of imaginary ac susceptibility yields relatively accurate values even for superconductors much smaller than λ -prime sub 0.

Author

A92-35898

TEMPERATURE DEPENDENCE OF NUCLEATION DENSITY OF CHEMICAL VAPOR DEPOSITION DIAMOND

YASUAKI HAYASHI (Ulvac Japan, Ltd., Tsukuba), WILLIAM DRAWL, and RUSSEL MESSIER (Pennsylvania State University, University Park) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 2B, Feb. 15, 1992, p. L193-L196. Research supported by Pennsylvania State University. refs Copyright

Ellipsometric monitoring is used to investigate the temperature dependence of the nucleation density of the CVD diamond. Nucleation density was greater than $10 \exp 10/\text{sq cm}$ in some ranges of temperature; nucleation density increased suddenly to 860 C and then gradually decreased in the range of higher temperatures. The results are explained by a change in the adsorption state of the precursor, from a physical to a chemical.

P.D.

A92-36063

PHOTON-INDUCED HOPPING IN $\text{Bi}_2\text{Sr}_2\text{Ca}(\text{O}_{0.5}\text{Y}_{0.5})\text{Cu}_2\text{O}(\text{Y})$ MASAYUKI SATO and KEIGO NAGASAKA (Tokyo, Science University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 2A, Feb. 1992, p. 227-230. refs (Contract MOESC-63631003)

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Transmission measurements of freestanding $\text{Bi}_2\text{Sr}_2\text{Ca}(\text{O}_{0.5}\text{Y}_{0.5})\text{Cu}_2\text{O}(\text{y})$ crystals have been made in the frequency range from 10 to 12,000/cm. Photon-induced hopping from occupied to unoccupied O-2p states was found in the absorption spectra from 10 to 5200/cm. The absorption edge at 11,500/cm due to charge transfer excitation and so-called mid-IR absorption from 1000 to 10,000/cm were also observed. Mid-IR absorption has been ascribed to a photon-induced hopping conduction edge continuing from the far-IR region.

Author

A92-36067

SIZE DEPENDENCE OF MORPHOLOGY OF DIAMOND SURFACES PREPARED BY DC ARC PLASMA JET CHEMICAL VAPOR DEPOSITION

KEIJI HIRABAYASHI, NORIKO I. KURIHARA (Canon, Inc., Research Center, Atsugi, Japan), NAOTO OHTAKE, and MASANORI YOSHIKAWA (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 2A, Feb. 1992, p. 355-360. refs Copyright

The size dependence of the surface morphology of diamond crystals prepared by the dc arc plasma jet CVD method has been observed. As the diamond particles gradually grew, the morphologies of the 111-plane and 100-plane surface underwent change; the 111-plane surface changed from a flat surface to a rough surface formed by the triangular microstructures and formed the 100-plane twin face and large wavy steps, whereas the 100-plane surface formed by growth steps using screw dislocations, defects, secondary nuclei and so on. The difference in the change of the surface morphology between the 111-plane surface and the 100-plane surface caused a difference in the growth mode; the 111-plane surface was formed by multinucleation, whereas the 100-plane surface was formed by single nucleation or very small nucleation points.

C.D.

A92-36297

CRYSTAL GROWTH OF SiC WHISKER FROM THE $\text{SiO}(\text{G})\text{-CO}$ SYSTEM

M. SAITO, S. NAGASHIMA, and A. KATO (Kyushu University, Fukuoka, Japan) Journal of Materials Science Letters (ISSN

0261-8028), vol. 11, no. 7, April 1, 1992, p. 373-376. refs Copyright

The growth of SiC whiskers via reaction between SiO gas and CO gas in the 1300-1500 C temperature range is discussed. Two distinct reaction paths are noted to differentiate needlelike from beaded whiskers; the presence of a carbonaceous solid is found to be essential to needle-whisker growth. Whisker diameter increases with deposition temperature, but is little changed by variations of partial pressure for either of the reactant gases in the 1450-1500 C range. The addition of H₂ gas enhanced needlelike whisker growth.

O.C.

A92-37021

SUPERCONDUCTING CERAMICS OF $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}(\text{x})$ PREPARED BY HEATING IN A VACUUM-SEALED VESSEL

YOSHIHIRO ABE, HIDEO HOSONO, WON-HYUK LEE, and TOSHIHIRO KASUGA (Nagoya Institute of Technology, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 18, May 4, 1992, p. 2300-2302. Research supported by MOESC and Chubu Electric Power Co. refs

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Results are presented showing that the as-quenched specimens of the melt of Ag₂O-doped $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}(\text{x})$ exhibit superconductivity when heated at temperatures around 800 C in an evacuated and sealed silica-glass tube. In view of the report of Abe et al. (1988, 1989) and Lee and Abe (1991) on the fabrication of superconducting Bi-Sr-Ca-Cu-O ceramics with a given shape (such as straight rod or coil), by quenching the melts into a silica-glass tube of a given shape, it is suggested that the present result indicates the feasibility of fabricating metal or glass-sealed superconducting ceramics with a desired shape.

I.S.

A92-37043

HETEROEPIITAXIAL INP LAYERS GROWN BY METALORGANIC CHEMICAL VAPOR DEPOSITION ON NOVEL GAAS ON Si BUFFERS OBTAINED BY MOLECULAR BEAM EPITAXY

D. J. OLEGO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), M. TAMURA (Optoelectronic Technology Research Laboratory, Tsukuba, Japan), Y. OKUNO, T. KAWANO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), and A. HASHIMOTO (Optoelectronic Technology Research Laboratory, Tsukuba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, no. 9, May 1, 1992, p. 4329-4332. refs Copyright

A92-37048

STRUCTURAL AND OPTOELECTRONIC PROPERTIES AND THEIR RELATIONSHIP WITH STRAIN RELAXATION IN HETEROEPIITAXIAL INP LAYERS GROWN ON GAAS SUBSTRATES

D. J. OLEGO, Y. OKUNO, T. KAWANO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), and M. TAMURA (Optoelectronic Technology Research Laboratory, Tsukuba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, no. 9, May 1, 1992, p. 4492-4501. refs Copyright

A92-37049

HETEROEPIITAXIAL GAAS LAYERS ON INP SUBSTRATES - RADIATIVE RECOMBINATIONS, STRAIN RELAXATION, STRUCTURAL PROPERTIES, AND COMPARISON WITH INP LAYERS ON GAAS

D. J. OLEGO, Y. OKUNO, T. KAWANO (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), and M. TAMURA (Optoelectronic Technology Research Laboratory, Tsukuba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 71, no. 9, May 1, 1992, p. 4502-4508. refs Copyright

A92-37090

ULTRAHIGH VACUUM STM STUDIES OF THE Bi-O SURFACE OF Bi_2Te_3

KAZUTO IKEDA, KENSHI TAKAMUKU, KOJI YAMAGUCHI, RITTAPORN ITTI, and NAOKI KOSHIZUKA (International Superconductivity Technology Center, Tokyo, Japan) *Journal of Materials Research* (ISSN 0884-2914), vol. 7, no. 5, May 1992, p. 1060-1062. Research supported by New Energy and Industrial Technology Development Organization. refs

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Observations of the Bi-O surface of superconductive Bi₂212 single crystals were carried out using an ultrahigh-vacuum scanning tunneling microscope (UHV-STM). In the atomic resolution images, surface corrugations, which correspond to the superstructure of the Bi-O surface in addition to Bi atom deficiencies, were observed. There were hollow lines along the ridges of the corrugations, which may be due to missing atom rows. Author

A92-37326

II-VI COMPOUNDS 1991; PROCEEDINGS OF THE 5TH INTERNATIONAL CONFERENCE, TAMANO, JAPAN, SEPT. 8-13, 1991

SHIGEO FUJITA, ED. (Kyoto University, Japan), TANEI NISHINO, ED. (Kobe University, Japan), and TSUNEMASA TAGUCHI, ED. (Osaka University, Suita, Japan) Conference sponsored by Japan Society of Applied Physics, Japan Society for the Promotion of Science, Commemorative Association for the Japan World Exposition (1970), et al. *Journal of Crystal Growth* (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, 1127 p. For individual items see A92-37327 to A92-37371.

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The present conference discusses topics concerning the crystal growth processing methods for narrow-gap and wide-gap materials, characterization methods for both material types, doping techniques, quantum well and heterostructure characteristics, quantum dots, defect and impurity effects, optical properties and excitons, semimagnetic materials, and applications of II-VI semiconductor compound-based devices. Among the applications discussed are compact blue lasers, bistable CdS-film optical devices, single-insulating thin-film cold cathodes, high-efficiency thin-film electroluminescent devices, CdS/CdTe heterojunction solar cells, double-insulating electroluminescent devices, full-color TV projectors based on electron beam-pumped semiconductor lasers, and blue/green lasers. O.C.

A92-37328

HIGH QUALITY P-CD(0.22)HG(0.78)TE GROWN BY LIQUID-PHASE EPITAXY

AKIHIRO TAKAMI, ZEMPEI KAWAZU, TOHRU TAKIGUCHI, KOTARO MITSUI, KAZUO MIZUGUCHI, TOSHIO MUROTANI (Mitsubishi Electric Corp., Microwave Devices Laboratory, Itami, Japan), KENJI YASUMURA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Amagasaki, Japan), TOSHIO KANNO, and MINORU SAGA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 16-19. refs

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The growth conditions of Cd(0.22)Hg(0.78)Te liquid-phase epitaxy are systematically studied using an open-tube horizontal slider apparatus. Each parameter was optimized, making it possible to obtain reproducibly high-quality p-Cd(0.22)Hg(0.78)Te epitaxial layers having an area of 15 x 20 sq mm with the following characteristics: surface roughness of +/- 0.5 micron, compositional uniformity of epitaxial layer of 0.220 +/- 0.001, carrier concentration of 1 x 10¹⁶ cm⁻³ at 77 K, and Hall mobility of 650 sq cm/V-s at 77 K. These characteristics are suitable for production of high-performance integrated detector arrays. Author

A92-37329

CD(X)HG(1-X)TE DOUBLE-LAYERS GROWN BY LIQUID PHASE EPITAXY

K. YASUMURA, T. MURAKAMI, M. SUIA, H. TAKADA, K.

TAKAHASHI, M. NUNOSHITA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Amagasaki, Japan), and Z. KAWAZU (Mitsubishi Electric Corp., Optoelectronic and Microwave Devices Research and Development Laboratory, Itami, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 20-23. refs

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Cd(x)Hg(1-x)Te double-layers have been grown by liquid phase epitaxy for the purpose of fabricating high-performance infrared detectors with small surface leakage current. The double-layer consisted of a first layer with x = 0.22 and a second layer with x = 0.25. The hole concentration and the mobility of the first layer, which is an 8-12 micron infrared-sensitive layer, were 1 x 10¹⁶ cm⁻³ and 650 sq cm/V-s (p-type) at 77 K, respectively. Compositional uniformity (x value) and surface roughness of the double-layer were within +/- 0.001 and +/- 0.5 micron, respectively. Author

A92-37330

EPITAXIAL GROWTH OF HgCdTe ON SAPPHIRE FOR PHOTOCONDUCTIVE DETECTORS

M. TANAKA, K. OZAKI, K. YAMAMOTO, H. EBE, and Y. MIYAMOTO (Fujitsu Laboratories, Ltd., Infrared Devices Laboratory, Atsugi, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 24-27. refs

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MOCVD is presently used to grow HgCdTe on a CdTe/sapphire substrate, in a way that effectively combines isothermal VPE and LPE by applying these processes consecutively in a closed tube. After isothermal VPE converted a CdTe layer to Hg(0.8)Cd(0.2)Te, the lattice mismatch between CdTe and HgCdTe is reduced; this conversion also reduces the compositional gradient generated by interdiffusion between the CdTe substrate and the epitaxial layer. Wafer quality was evaluated after Hg-atmosphere annealing in the role of photoconductive detector. The results obtained are comparable to those of conventional LPE-grown detectors. O.C.

A92-37331

METALORGANIC CHEMICAL VAPOR DEPOSITION GROWTH OF CDTE ON GAAS IN A VERTICAL REACTOR WITH MULTI-NOZZLES

H. TAKIGAWA, H. NISHINO, T. SAITO, S. MURAKAMI, and K. SHINOHARA (Fujitsu Laboratories, Ltd., Infrared Devices Laboratory, Atsugi, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 28-32. refs

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A vertical, rotating-susceptor reactor with linearly aligned multinozzles has been used to effect the MOCVD growth of CdTe films on (100)-plane GaAs substrates. Specular single (-1 -1 -1)B-plane CdTe films were obtained throughout the 3-inch substrate wafer by adjusting the VI/II ratio individually for each of the nozzles. No macroscopic defects, such as cellular structures or antiphase domains, have been observed on etched HgCdTe surfaces used as substrates. O.C.

A92-37332

COMPOSITIONAL PROFILE OF HgCdTe IN METALORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD) SYSTEM WITH MULTINOZZLES

S. MURAKAMI, Y. SAKACHI, H. NISHINO, T. SAITO, K. SHINOHARA, and H. TAKIGAWA (Fujitsu Laboratories, Ltd., Atsugi, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) *Journal of Crystal Growth* (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 33-36. refs

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The nozzle-configuration dependence of the compositional

profile of $\text{Hg}(1-x)\text{Cd}(x)\text{Te}$ grown in an MOCVD apparatus having multinozzle injectors and a rotating susceptor in a vertical apparatus has been studied. The x-value peak is found to be highest just below the nozzle, and to shift toward the rotation center when the epilayer is grown from an off-center nozzle with rotation. It is established that eight nozzle ejectors are required to grow the epilayer on a 3-inch substrate within a Delta-x compositional variation of 0.002. O.C.

A92-37333

HG(1-X)CD(X)TE EPITAXIAL LAYERS GROWN BY LOW MERCURY PARTIAL PRESSURE METALORGANIC CHEMICAL VAPOR DEPOSITION AND EXTENDED DEFECT CHARACTERIZATION

K. SHIGENAKA, T. UEMOTO, L. SUGIURA, K. ICHIZONO, K. HIRAHARA (Toshiba Corp., Research and Development Center, Kawasaki, Japan), T. KANNO, and M. SAGA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 37-43. refs
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The direct alloy growth (DAG) MOCVD process has been used for HgCdTe growth under low Hg partial pressure, in order to improve depth-compositional uniformity, misfit dislocation density, and the lamella twin density. The result has been an imparting of limited growth to mercury transport, as in the conventional growth of III-V compounds by MOCVD. The $\text{Hg}(0.8)\text{Cd}(0.2)\text{Te}$ layers thus obtained exhibited improved depth compositional uniformity and dislocation density. O.C.

A92-37334

THE GROWTH RATE OF $\text{Cd}(x)\text{Hg}(1-x)\text{Te}$ GROWN BY METALORGANIC CHEMICAL VAPOR DEPOSITION

H. TAKADA, T. MURAKAMI, M. SUIA, K. YASUMURA, Y. ENDO, K. TAKAHASHI, and M. NUNOSHITA (Mitsubishi Electric Corp., Materials and Electronic Devices Laboratory, Amagasaki, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 44-48. refs
Copyright

$\text{Cd}(x)\text{Hg}(1-x)\text{Te}$ epitaxial layers have been grown by metalorganic chemical vapor deposition on CdTe substrates oriented 0-4 deg off (100) toward the 0 0 -1 line type, using dimethylcadmium (DMCd), diisopropyltelluride (DIPTe), and elemental mercury (Hg). Typically the $\text{Cd}(x)\text{Hg}(1-x)\text{Te}$ layers exhibited hillock densities of $(1.5-3.0) \times 10^5 \text{ exp } 2/\text{sq cm}$, and FWHM in XRD of 130-180 arcsec. The growth rate and the compositional ratio x, and their dependences on the flow rates of DIPTe and DMCd have been examined. By considering the growth mechanism in the light of these results, it is concluded that the growth involves the formation of an adduct. Author

A92-37335

EFFECTS OF MERCURY PARTIAL PRESSURE ON DEFECTS IN HgTe EPITAXIAL LAYERS GROWN BY METALORGANIC CHEMICAL VAPOR DEPOSITION

K. SHIGENAKA (Toshiba Corp., Research and Development Center, Kawasaki, Japan), T. KANNO, M. SAGA (Japan Defense Agency, Technical Research and Development Institute, Tokyo), T. UEMOTO, L. SUGIURA, K. ICHIZONO, and K. HIRAHARA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 49-53. refs
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A92-37336

COMPOSITION CONTROL IN $\text{Hg}(1-x)\text{Cd}(x)\text{Te}$ GROWTH BY PHOTOASSISTED MOCVD USING AN EXCIMER LASER

TOSHIYUKI TERADA, YASUHISA FUJITA, SATOSHI FUJII, and TOHRU IUCHI (Nippon Steel Corp., Electronics Research Laboratories, Kawasaki, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 54-57. refs
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$\text{Hg}(1-x)\text{Cd}(x)\text{Te}$ growth by photoassisted MOCVD using a KrF excimer laser is reported. By varying laser repetition rate, it has been found that the composition x of $\text{Hg}(1-x)\text{Cd}(x)\text{Te}$ films can be controlled. As the laser repetition rate increases from 100 to 400 Hz, the composition x decreases from 0.80 to 0.20. Using this technique, $\text{Hg}(0.80)\text{Cd}(0.20)\text{Te}/\text{Hg}(0.20)\text{Cd}(0.80)\text{Te}$ multilayers can be successfully grown. In addition, the properties of a $\text{Hg}(0.80)\text{Cd}(0.20)\text{Te}$ film are characterized by secondary-ion mass spectrometry (SIMS) and Hall measurements. Author

A92-37337

UNDOPED ZnSe SINGLE CRYSTAL GROWTH BY THE VERTICAL BRIDGMAN METHOD

HIROAKI YOSHIDA, TAKASHI FUJII, ATSUSHI KAMATA, and YUJI NAKATA (Toshiba Corp., Research and Development Center, Kawasaki, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 75-79. refs
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Twin-free undoped ZnSe crystals have been grown by the vertical Bridgman method. The single crystals were as large as 25 mm in diameter by 25 mm in length. The macrodefects, such as voids and twins, were reduced drastically by selecting the downward velocity of the crucible and the angle of the crucible cone. Large twin-free crystals were obtained when the velocity was not more than 4 mm/h, and the crucible cone angle was either 30 or 45 deg. For crucible velocities greater than 4 mm/h, only polycrystalline material was obtained. In high purity ingots, the concentrations of various impurities were found to be either less than 1 ppm or under the detection limit. Author

A92-37338

DISLOCATION REDUCTION IN HgCdTe EPILAYERS ON GaAs BY USING $\text{CdTe}/\text{CdZnTe}$ STRAINED-LAYER SUPERLATTICES IN CdTe LAYERS

I. SUGIYAMA, A. HOBBS, T. SAITO, O. UEDA, K. SHINOHARA, and H. TAKIGAWA (Fujitsu Laboratories, Ltd., Atsugi, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 161-165. refs
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A92-37340

TWIN-FORMATION MECHANISMS FOR HgCdTe EPILAYERS

M. KAWANO, N. ODA, T. SASAKI (NEC Corp., Material Development Center, Kawasaki, Japan), T. ICHIHASHI (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan), S. IJIMA (NEC Corp., Research and Development Group, Tsukuba, Japan), T. KANNO, and M. SAGA (Japan Defense Agency, Technical Research and Development Institute, Tokyo) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 171-176. refs
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HgCdTe epilayers were grown on CdZnTe substrates by molecular beam epitaxy, and the substrate orientation influence on growth defects was investigated. In the $\text{HgCdTe}(-1 -1 -1)\text{B}$ epilayers, many 'lamellar' and/or 'columnar' twins were observed, while twin-related triangular hillocks were observed in the (110) and (112)A epilayers. On the other hand, $(-1 -1 -2)\text{B}$ epilayers have smooth surface morphology, and no twins were observed. Resulting possible twin-formation mechanisms are discussed. Author

A92-37343

COMPOSITION CHARACTERIZATION METHODS FOR HgCdTe EPILAYERS GROWN BY MOLECULAR BEAM EPITAXY

N. ODA (NEC Corp., Material Development Center, Kawasaki, Japan), T. KANNO, M. SAGA (Japan Defense Agency, Technical Research and Development Institute, Tokyo), R. OIKAWA (NEC Corp., Material Development Center, Kawasaki, Japan), and Y. MAEJIMA (SORTEC Corp., Tsukuba, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 193-196. refs

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Cd compositions of HgCdTe epilayers and photodiodes were estimated, respectively, by measuring infrared transmission curves at 300 K and spectral response curves at 77 K, along with using an empirical formula on energy band gap for HgCdTe. Comparing these two compositions, a linear relationship between them was established with an accuracy of ± 0.002 . Author

A92-37346

ELECTRON MOBILITY IN HgCdTe NEAR THE ZERO-BAND-GAP GROWN BY MOLECULAR BEAM EPITAXY

S. SONE, N. ODA, T. SASAKI, and M. KAWANO (NEC Corp., Material Development Center, Kawasaki, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 218-221. refs

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The behavior on electron mobility in Hg(1-x)Cd(x)Te near the zero-band-gap (x less than 0.2) grown by molecular beam epitaxy has been studied. The mobility at 77 K significantly varies with changes in alloy composition x . High mobility of 5.5×10^5 cm²/V-s is observed as a peak value near $x = 0.15$, which corresponds to the zero-band-gap at 77 K, determined by the empirical formula of Hansen et al. Scattering mechanisms for the electrons are also discussed. Author

A92-37348

TRANSMISSION ELECTRON MICROSCOPIC EVALUATION OF METALORGANIC CHEMICAL VAPOR DEPOSITION-GROWN CdTe CRYSTALS ON SAPPHIRE SUBSTRATES

O. UEDA, K. MARUYAMA, A. HOBBS, and K. SHINOHARA (Fujitsu Laboratories, Ltd., Atsugi, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 266-270. refs

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A92-37358

SUPERRADIATIVE EMISSION FROM CDS MICROCRYSTALLITES

KAZUHIKO MISAWA (Tokyo, University, Japan), HIROSHI YAO, TOYO HARU HAYASHI (Mitsui Toatsu Chemicals, Inc., Central Research Institute, Yokohama, Japan), and TAKAYOSHI KOBAYASHI (Tokyo, University, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 617-621. Research supported by MOESC, Nippon Sheet Glass Foundation, and New Energy and Industrial Technology Development Organization. refs

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The excitonic superradiance from CdS microcrystallites is observed. The decay rate due to the direct recombination of an exciton in the microcrystallite was almost proportional to the particle volume, suggesting its superradiative decay property. The radiative decay rate was almost constant below a certain threshold temperature and it decreased linearly with inverse temperature. The threshold temperatures for thermal quenching of microcrystallites of 25 and 29 Å in radius were measured to be 45 and 30 K, respectively,

which corresponds to the calculated frequencies of radial compression mode of 30/cm (43 K) and 26/cm (37 K), respectively. Author

A92-37360

BAND-GAP RENORMALIZATION AND OPTICAL GAIN FORMATION IN HIGHLY EXCITED CDSE

Y. MASUMOTO (Tsukuba, University, Japan), B. FLUEGEL, K. MEISSNER, S. W. KOCH, R. BINDER, A. PAUL, and N. PEYGHAMBARIAN (Arizona, University, Tucson) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 732-737. Research supported by NSF, U.S. Army, Joint Services Optical Program, et al. refs

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This paper reports the direct femtosecond observation of the dynamical bandgap renormalization and optical gain formation in a highly excited CdSe crystal. Interband excitation with 60 fs pulses results in broadening of the exciton at 0 fs, exciton bleaching and bandgap renormalization at 80 fs, and development of optical gain below the exciton level after 80 fs with rise time of 100 fs. At 380 fs, the optical gain reaches its maximum value and subsequently decreases slowly. Stimulated plasma luminescence has a peak around the energy where maximum gain is observed. The data are discussed in terms of plasma cooling, screening, state filling, and band-gap renormalization. Author

A92-37362

EPITAXIAL GROWTH OF ZINCBLLENDE MNTE FILMS AS A NEW MAGNETO-OPTICAL MATERIAL

H. ANNO, T. KOYANAGI, and K. MATSUBARA (Yamaguchi University, Tokiwadai, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 816-819. refs

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Epitaxial films of MnTe with a zincblende structure have been successfully grown on GaAs (100) and sapphire (0001) substrates using the ionized-cluster beam deposition technique. The values of the lattice constant, 6.34 Å, and the optical band gap, 2.92 eV (300 K), reveal that the MnTe films obtained have the previously hypothetical zincblende MnTe structure. In the Faraday rotation spectrum of the zincblende MnTe film, a large dispersion is observed near the band gap energy, and the peak value of the Verdet constant is about 0.6 deg/cm.G. From the X-ray photoelectron spectroscopy and the intra-Mn absorption, the Mn3d states of zincblende MnTe are investigated. Author

A92-37384

MAGNETO-OPTICAL PROPERTIES OF LOW-DIMENSIONAL EXCITONS IN MICROCRYSTALS AND SUPERLATTICES OF Cd(1-x)Mn(x)Te

KYOICHI SUZUKI, MAMORU NAKAMURA, IZURU SOUMA, KOHEI YANATA, YASUO OKA (Tohoku University, Sendai, Japan), HIROSHI FUJIYASU (Shizuoka University, Japan), and HIROSHI NOMA (Fuji Seiki, Inc., Shizuoka, Japan) (II-VI Compounds 1991; Proceedings of the 5th International Conference, Tamano, Japan, Sept. 8-13, 1991. A92-37326 15-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 117, no. 1-4, Feb. 1992, p. 881-885. Research supported by MOESC. refs

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Studies have been made on low-dimensional excitons in microcrystals and superlattices of Cd(1-x)Mn(x)Te fabricated by RF sputtering and hot-wall epitaxy. Properties of confined excitons in quantum boxes and in quantum wells, which are interacting with the Mn ions, are discussed from the results of the magnetooptical and transient spectroscopies. Author

A92-37487

COMPETITION BETWEEN SUPERCONDUCTIVITY AND A NEW 20 K PHASE IN BETA-(BEDT-TTF)2I3 - SPECIFIC HEAT MEASUREMENTS

N. A. FORTUNE, K. MURATA (Electrotechnical Laboratory, Tsukuba, Japan), K. IKEDA, and T. TAKAHASHI (Gakushuin University, Tokyo, Japan) *Physical Review Letters* (ISSN 0031-9007), vol. 68, no. 19, May 11, 1992, p. 2933-2936. Research supported by Science and Technology Agency and Agency of Industrial Science and Technology of Japan. refs
(Contract NSF INT-89-02030)

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Direct calorimetric evidence is presented for a new transition at $T^* = 22.25$ K in the metallic state of quasi-2D organic superconductor beta-(BEDT-TTF)₂I₃ at ambient pressure, as suggested by a previous measurement of the temperature-dependent Hall coefficient. The apparent reduction in the effective electronic density of states at T^* quantitatively explains for the first time the suppression of T_c from the pressure-stabilized 'high- T_c ' value of 8 K to the ambient-pressure cooled 'low- T_c ' value of 1.5 K. Author

A92-37690

YBaCuO THIN-FILM GROWTH ON ELECTROOPTIC LiNbO3 SUBSTRATE WITH BUFFER LAYER

SHOICHI HASHIGUCHI, EUNGI MIN (Sumitomo Cement, Ltd., Central Research Laboratory, Funabashi, Japan), KEN SAKUTA, and TAKESHI KOBAYASHI (Osaka University, Toyonaka, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 780-785. refs

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Oxide superconducting YBaCuO thin films were grown on Y- and Z-cut LiNbO₃(LN) electrooptic crystal substrates with and without buffer layers, and their film crystallinity was closely investigated by X-ray diffraction, transmission electron microscopy, reflection high-energy electron diffraction, and Auger electron spectroscopy. Due to the intensive reaction, direct deposition of films resulted in poor quality. When sputtered 111 plane-MgO film was introduced as a buffer layer, significant diffusion of constituent atoms was unavoidable among YBaCuO, MgO, and LN. As a result, the superconductivity of the YBaCuO layer was substantially degraded. The Y₂O₃-stabilized ZrO₂(YSZ) grown by sputtering, followed by wet O₂ anneal, served as a good buffer layer for Y₁Ba₂Cu₃O(y) films on LN substrates, and epitaxial growth of 001 plane-Y₁Ba₂Cu₃O(y) with $T(c0) = 89$ K was reproducibly obtained on Y-cut LN substrates. Author

A92-37696

DIAMOND SYNTHESIS BY THE MICROWAVE PLASMA CHEMICAL VAPOR DEPOSITION METHOD USING THE PRETREATED CARBON DIOXIDE AND HYDROGEN MIXED-GAS SYSTEM

SATOSHI KATSUMATA (Idemitsu Petrochemical Co., Ltd., Dept. of Planning and Development, Chiba, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 868-871. refs

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High-quality diamond was obtained by the microwave-plasma-assisted chemical-vapor deposition (plasma CVD) method using the pretreated carbon dioxide and hydrogen mixed-gas system. The pretreatment method is as follows: first, CO₂ and H₂ pass through the prereactor where plasma is generated by microwave discharge, and then the reactant passes through the cold trap at around 185 K in order to remove water (H₂O) produced in the plasma from CO₂ and H₂. The residue of the pretreated CO₂ and H₂ mixed gas, which consists of CO, CO₂ and H₂, is introduced into the main reactor where diamond is synthesized. Diamond can grow to a feed ratio of CO₂/H₂ = 25/100 sccm. Plasma diagnosis was performed using optical emission spectroscopy and gas chromatography. Author

A92-37698

ELECTRONIC PROPERTIES OF GAAS THIN FILM DEPOSITED ON SILICA SUBSTRATE BY RF SPUTTERING

SEIJI TSUJI (Mitsubishi Cable Industries, Ltd., Central Research Laboratory, Itami, Japan), EIJI IRI (Mitsubishi Cable Industries, Ltd., Electro-Communication Laboratory, Itami, Japan), and HIDEYUKI TAKAKURA (Toyama Prefectural University, Japan) *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), vol. 31, no. 3, March 1992, p. 880, 881. refs

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Electrical conductivity is measured on GaAs thin film deposited by RF sputtering to analyze temperature dependence. The film has very low conductivity in the range of $10 \exp -4/\text{ohm/cm}$, and the activation energy of the conductivity is 0.67 eV. The conductivity is strongly limited by the high density of deep oxygen impurity as well as by grain boundaries. Author

A92-37793

EFFECT OF Y SUBSTITUTION FOR CA IN Bi2Sr2CaCu2O(8+D) SUPERCONDUCTING FILMS PREPARED BY LIQUID PHASE EPITAXIAL METHOD

JAE S. SHIN, HIROYUKI ENOMOTO, TAKESHI KISHIMOTO, and HAJIME OZAKI (Waseda University, Tokyo, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 31, no. 3B, March 15, 1992, p. L320-L323. refs

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The effect of Y substitution for Ca on superconducting properties has been investigated in Bi₂Sr₂CaCu₂O(8+d) films prepared by liquid phase epitaxial method. The Y concentration in the film $x(s)$ increased in proportion to that in the solution $x(L)$ in the region of $x(L) = 0 - 0.2$, and then it was saturated. The incorporation ratio of Y in solid and in liquid $x(s)/x(L)$ for $x(L) = 0 - 0.2$ was found to be about three. The $x(s)$ dependences of the zero-resistance temperature and the carrier concentration showed that about half of the Y concentration incorporated in the films contributes to the effect of the Y substitution obtained in sintered materials. Author

A92-37794

HIGH-TEMPERATURE SUPERCONDUCTIVITY AND NORMAL-STATE ANOMALY

MASANORI SUGAHARA (Yokohama National University, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 31, no. 3B, March 15, 1992, p. L324-L326. refs

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A conduction experiment on LaSrCuO shows that (1) the carrier density dependence of the collision frequency of holes in the normal state has dips when $x\text{-prime} = 4 \exp -N$ ($N = 1, 2, 3, \dots$), where $x\text{-prime}$ is the hole density per one CuO₂ cell, and that (2) superconductivity appears in the interval $x\text{-prime}$ between $4 \exp -2$ and $4 \exp -1$. A model is proposed in which the normal state of LaSrCuO is characterized by localized hole pairing with some hierarchic structures even up to 300 K. Author

A92-37795

PHONON EFFECT ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF A SMALL PARTICLE

AKIRA TAMURA (Saitama Institute of Technology, Japan) *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), vol. 31, no. 3B, March 15, 1992, p. L334-L336. refs

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Using an elastic vibration model for phonons of a small metallic particle, size dependence of the superconducting transition temperature T_c is derived. It is shown that enhancement of T_c with decrease in particle size stems mainly from the associated increase of surface modes contribution. Comparison is made with other treatments and inconsistencies are noted. Author

A92-37798

SUPERCONDUCTING 2201 PHASE IN THE Bi2PR(X)CA(2-X)CUO(Z) SYSTEM

HIROYUKI SASAKURA, SHINNOSUKE MINAMIGAWA, HIROSHI TERAOKA, AKINORI HIROSE, SATORU NOGUCHI, and KIICHI OKUDA (Osaka Prefecture University, Sakai, Japan) *Japanese*

Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 3B, March 1, 1992, p. L221-L223. refs
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A new Sr-free Bi cuprate superconductor has been synthesized in the $\text{Bi}_2\text{Pr}(x)\text{Ca}(2-x)\text{CuO}(z)$ system. The superconducting phase was isostructural to the 2201 phase ($\text{Bi}_2\text{Sr}_2\text{CuO}_z$). The almost-single phase was attained at the nominal composition of $x = 0.7$ -0.8. The sample with $x = 0.7$ showed a superconducting onset at about 12 K and zero resistivity at about 6 K. The crystal structure had a pseudotetragonal symmetry with $a = 0.5381$ nm and $c = 2.381$ nm. Author

A92-37799

ANOMALOUS THERMAL EXPANSION IN $\text{La}(2-x)\text{Sr}(x)\text{CuO}_4$

YASUHIRO ONO and SHIN-YA NARITA (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 3B, March 1, 1992, p. L224-L226. refs

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Lattice constants of $\text{La}(2-x)\text{Sr}(x)\text{CuO}_4$ are precisely determined as a function of temperature from 13 K to room temperature by Rietveld analysis using X-ray powder diffraction data. In $\text{La}(1.95)\text{Sr}(0.05)\text{CuO}_4$ and $\text{La}(1.90)\text{Sr}(0.10)\text{CuO}_4$, unit cell volumes show a small change below 50 K and 70 K, respectively. Anomalous volume change around T_c found in $\text{La}(1.85)\text{Sr}(0.15)\text{CuO}_4$ and $\text{La}(1.90)\text{Sr}(0.10)\text{CuO}_4$ cannot be explained only by superconductivity. The comparison between lattice constants in all samples is suggestive of the structural phase transition preceding the appearance of superconductivity. Author

A92-37815

MECHANISM OF THE STEP GROWTH OF DIAMOND CRYSTALS WITH CARBON ATOMS. I - EPITAXIAL GROWTH OF (001) SURFACES IN THE LOWEST SINGLET STATE WITH CARBON ATOMS

M. TSUDA, S. OIKAWA, S. FURUKAWA, C. SEKINE, and M. HATA (Chiba University, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, no. 5, May 1992, p. 1482-1489. Research supported by MOESC. refs

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A mechanism of the diamond synthesis in hydrocarbon plasmas was investigated in the case where carbon atoms are the reactive species for the epitaxial growth taking place on the (001) surfaces in the lowest singlet state. The results obtained are as follows: (1) two types of the S(B) step are generated in the S(B) step growth (i.e., the S(B) step type I and the S(B) step type II); (2) the S(B) step growth is the dimer row growth; (3) the S(A) step growth is initiated by the nucleation at the S(A) step edge and followed by the dimer row propagation; (4) the nucleus is a dimer which has the reactivity like a sigma-type dangling bond which propagates a dimer row to both sides of the nucleus along the S(A) step edge; and (5) the propagation process of a dimer row in the S(A) step growth follows exactly the same mechanism as the S(B) step growth does. Author

A92-37970

ON DIMER PAIRING MECHANISM OF SUPERCONDUCTIVITY

MASATOSHI IMADA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 423-427. Research supported by MOESC. refs

Copyright

Physical properties in a dimer pairing superconductor are examined. The pairing has a finite net momentum and breaks lattice translational symmetry as well as the gauge symmetry. The mean field equations for the dimerized t-J model and the spin-Peierls t-J model are solved numerically to discuss novel features of the dimer pairing mechanism. The dynamical spin susceptibility is calculated to discuss spin excitations in the superconducting state. The energy gap opens over the Fermi surface without nodes, while the Hebel-Slichter peak is absent in the NMR relaxation rate. Author

A92-37971

THERMOELECTRIC POWER OF GRAPHITE INTERCALATION COMPOUNDS WITH IODINE MONOCHLORIDE

KOJI KOBAYASHI, HISASHI OSHIMA, KO SUGIHARA (Nihon University, Funabashi, Japan), and TAKURO TSUZUKU (Nihon University, Tokyo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 596-601. refs

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The thermoelectric power (TEP) of stage-1, -2, and -3 iodine monochloride-graphite intercalation compounds (ICI-GICs) is measured at 5-300 K. The values of TEP increase linearly with temperature at low temperatures, and the phonon-drag effect is credited with causing the saturation behavior noted in the TEPs at more than 200 K. An analysis of the stage-1 and -2 TEP results based on Sugihara's (1983) theory yields accurate results when parameters for relaxation time are included. The parameter set includes phonon relaxation caused by strain-field and/or point defects as well as phonon-phonon interaction. C.C.S.

A92-37972

MEISSNER EFFECT DUE TO COOPER PAIRS BETWEEN BLOCH ELECTRONS - ANALYSIS OF PENETRATION DEPTH OF $\text{YBa}_2\text{Cu}_3\text{O}_7$

FUSAYOSHI J. OHKAWA (Hokkaido University, Sapporo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 631-638. refs

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A92-37973

SECOND SUPERCONDUCTING TRANSITION DRIVEN BY CHARGE DENSITY WAVE

FUSAYOSHI J. OHKAWA (Hokkaido University, Sapporo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 639-648. refs

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Instability of charge density wave can drive successive superconducting transitions. The transition at a lower temperature can be detected by the softening of phonons, whose symmetry is compatible with the symmetry of the product of the two superconducting order parameters. It is argued that the second transition is responsible for tiny anomalies around $T_{c2} = 35$ K in high-temperature superconductors YBaCu_3O_7 with superconducting critical temperature $T_c = 90$ K. It is also argued that the anisotropic Cooper pairing is responsible for high-temperature superconductivity not only in YBaCu_3O_7 but also in the other cuprate oxides. Author

A92-38037

SUPERCONDUCTIVITY AT 110 K IN THE INFINITE-LAYER COMPOUND $(\text{Sr}(1-x)\text{Ca}(x))(1-y)\text{CuO}_2$

M. AZUMA, Z. HIROI, M. TAKANO, Y. BANDO (Kyoto University, Uji, Japan), and Y. TAKEDA (Mie University, Tsu, Japan) Nature (ISSN 0028-0836), vol. 356, no. 6372, April 30, 1992, p. 775, 776. Research supported by MOESC. refs

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The isolation of a superconducting alkaline-earth-deficient infinite-layer phase, $(\text{Ca}(1-x)\text{Sr}(x))(1-y)\text{CuO}_2$ (y about 0.1) with T_c up to 110 K is reported. The data suggest that the present superconductor is p-type, with the carriers arising from calcium and strontium vacancies. High-resolution electron micrographs reveal defect layers which may be where the calcium and strontium vacancies are concentrated. C.D.

A92-38043

MANY-BODY EFFECTS ON NUCLEAR RELAXATION RATES IN SUPERCONDUCTING STATES OF COPPER OXIDES

SATOSHI FUJIMOTO (Kyoto University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 765-769. Research supported by MOESC. refs

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The effects of electron correlation on the nuclear spin-lattice relaxation rate (SLRR) and the Knight shift of high- T_c superconductors are studied. The main effects are a quasi-particle

damping and the vertex enhancement of a spin susceptibility. The former involves a pair breaking effect induced by electron correlation, and brings about the suppression of the coherence peak. The latter is reduced by increasing gap below T_c , and results in the sharp decrease of (SLRR) and the Knight shift. Taking into account these effects, the temperature dependence of these quantities is fit to the experimental results by assuming s-wave or d-wave BCS-like superconductivity. For d-wave pairings, good fits can be obtained. In contrast, it is rather difficult to achieve a fit for s-wave pairings. Author

A92-38044**NUCLEAR SPIN RELAXATION AT PLANAR COPPER AND OXYGEN SITES IN $YBa_2Cu_3O_{(6.96)}$**

YOSHIKUNI YOSHINARI, HIROSHI YASUOKA, and YUTAKA UEDA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 770-773. Research supported by MOESC. refs

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The temperature dependence of the spin lattice relaxation rates (SLRRs) at the planar copper Cu(2) and oxygen O(2, 3) sites in the high- T_c superconductor $YBa_2Cu_3O_{(6.96)}$ has been re-examined using an oriented powder sample. The existence of a characteristic region around T_c where the degrees of suppression of both (SLRRs) are equivalent is confirmed. At the lower temperature, the decrease of the relaxation rate at the Cu(2) sites was more rapid than that of the O(2, 3) sites, and obeyed the power law against the decrease of the O(2, 3) relaxation rate. This is in contrast with a previous report. Author

A92-38047**CRYSTAL STRUCTURE OF $Pb_2Sr_2MCu_3O_{(8+\delta)}$ SYSTEM (M = ND, SM, EU, GD, DY, Y(1-X)CA(X), HO AND ER)**

TAKASHI MOCHIKU and KAZUO KADOWAKI (National Research Institute for Metals, Tsukuba, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 881-890. refs

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An analysis of the crystal structure of $Pb_2Sr_2MCu_3O_{(8+\delta)}$ system (M = Nd, Sm, Eu, Gd, Dy, Y(1-x)Ca(x), Ho and Er) is performed by the Rietveld technique of X-ray powder diffraction data. It is demonstrated that the lattice parameters and the interatomic distances vary with the ionic radius of lanthanoids. The systematic variation of the atomic arrangement in the unit cell which consists of stacking of sheets having a different role is argued. R.E.P.

A92-38048**OPTICAL CONDUCTIVITY OF HEAVY-ELECTRON LIQUIDS IN THE MOTT-TRANSITION REGION**

FUSAYOSHI J. OHKAWA (Hokkaido University, Sapporo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 952-959. refs

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The optical conductivity of the Hubbard model with strong electron correlation is examined in less-than and almost half-filled cases by assuming the formation of the Gutzwiller heavy-electron band (HEB) at the top of the lower Hubbard band (LHB), which is predicted by recent theories. The optical conductivity is the superposition of the Drude contribution within the HEB and excitations among the LHB, the HEB, and the upper Hubbard band (UHB). Their intensities are approximately proportional to $1-n$ except the excitations from the LHB to the UHB, n being the average number of electrons per unit cell. It is argued that the excitations from the LHB to the HEB are responsible for the anomalous spectra at mid-infrared frequencies of the optical conductivity and the Raman scattering of the high-temperature cuprate-oxide superconductors. Author

A92-38049**APPLICATION OF MODIFIED SPIN WAVE TO MAGNON-RAMAN SCATTERING PROCESS IN QUANTUM HEISENBERG ANTIFERROMAGNETIC SYSTEM ON A SQUARE LATTICE**

TOSHIHIKO SUZUKI and YUHEI NATSUME (Chiba University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 3, March 1992, p. 998-1010. Research supported by MOESC. refs

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The quantum antiferromagnetism on a square lattice is noted to be of interest in connection with the understanding of superconducting phenomena on a CuO_2 plane in perovskite compounds. The expression of magnon Raman scattering for the instance where the sublattice magnetization disappears by the quantum effect, is made for the Heisenberg antiferromagnetic system on a square lattice by the technique of modified spin wave, on the basis of the exchange scattering mechanism. R.E.P.

A92-39692**SURFACTANT EPITAXY OF SI ON SI(111) SURFACE MEDIATED BY A SN LAYER. I - REFLECTION ELECTRON MICROSCOPE OBSERVATION OF THE GROWTH WITH AND WITHOUT A SN LAYER MEDIATE THE STEP FLOW**

S. IWANARI and K. TAKAYANAGI (Tokyo Institute of Technology, Yokohama, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 119, no. 3-4, May 1992, p. 229-240. Research supported by MOESC. refs

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A92-39693**SURFACTANT EPITAXY OF SI ON SI(111) SURFACE MEDIATED BY A SN LAYER. II - CRITICAL STEP FLOW OF THE GROWTH WITH AND WITHOUT MEDIATE**

S. IWANARI, Y. KIMURA, and K. TAKAYANAGI (Tokyo Institute of Technology, Yokohama, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 119, no. 3-4, May 1992, p. 241-247. Research supported by MOESC. refs

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A92-39697**MINIMIZATION OF LATTICE PARAMETER CHANGE IN CZOCHRALSKI GROWN $(Gd_{(1-x)}Y_x)_{3}Ga_5O_{12}$ GARNET SINGLE CRYSTAL**

HIDEO KIMURA, TAKENORI NUMAZAWA, MITSUNORI SATO, HIROSHI MAEDA (National Research Institute for Metals, Tsukuba, Japan), and MASARU SAKAMOTO (Nippon Mining Co., Ltd., Toda, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 119, no. 3-4, May 1992, p. 313-316. refs

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The Czochralski technique is used to grow $(Gd_{(1-x)}Y_x)_{3}Ga_5O_{12}$ single crystals. It is shown that single crystals of rare-earth garnet solution with an extremely small lattice parameter change along the growth direction can be grown using the combination of the solid solution effect and the nonstoichiometry effect. The grown single crystal is crack-free and considered to be one of the promising magnetic refrigerants of a magnetic refrigerator to generate a low temperature atmosphere below 1 K. O.G.

A92-40573**SYNTHESIS OF CUO FILMS USING MASS-SEPARATED, LOW-ENERGY $O(+)$ ION BEAMS**

R. KITA, T. HASE, R. ITTI, M. SASAKI, T. MORISHITA, and S. TANAKA (International Superconductivity Technology Center, Tokyo, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 21, May 25, 1992, p. 2684, 2685. Research supported by New Energy and Industrial Technology Development Organization. refs

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CuO thin films are synthesized by means of low-energy and high-density $O(+)$ -ion beams, mass separated from an oxygen

plasma. A 50-eV, 47-microA/sq cm O(+) ion beam successfully produces CuO at a growth rate of 0.04 Å/s by simultaneous deposition of Cu metal on MgO 100 plane. O(+) beams have greater potential for oxidation than O₂ gas from the viewpoint of the flux necessary to form CuO. Author

A92-40574

FLUX PINNING BY A-AXIS GRAINS IN C-AXIS-ORIENTED Y-Ba-Cu-O FILMS

H. FUKE, H. YOSHINO, M. YAMAZAKI, T. D. THANH, S. NAKAMURA, K. ANDO (Toshiba Corp., Research and Development Center, Kawasaki, Japan), and Y. KOBAYASHI (Super-GM, Osaka, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 21, May 25, 1992, p. 2686-2688. Research supported by New Energy and Industrial Technology Development Organization. refs

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The relationship between the microstructures and pinning forces is investigated by measuring the magnetic-field dependence and angular dependence of J_c in several kinds of YBCO thin films having different microstructures. A high-J_c value was kept even when the magnetic field was applied perpendicular to the film plane in the case of a c-axis-oriented film which was studded with a-axis-oriented grains. The boundaries between the a-axis-oriented grain and the c-axis-oriented grain are considered to be effective as pinning centers. Author

A92-40917

MOMBE GROWTH CHARACTERISTICS OF ANTIMONIDE COMPOUNDS

H. ASAMI, T. KANEKO, Y. OKUNO, Y. ITANI, K. ASAMI, and S. GONDA (Osaka University, Ibaraki, Japan) (Chemical beam epitaxy and related growth techniques 1991; Proceedings of the 3rd International Conference /ICCBE-3/, Oxford, England, Sept. 1-5, 1991. A92-40901 16-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 120, no. 1-4, May 1992, p. 252-260. Research supported by MOESC. refs

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The growth characteristics of antimonide compounds grown by metal organic molecular beam epitaxy (MOMBE) and using trimethylindium, triethylgallium (TEGa), and triisobutylaluminum (TIBAl) as group III sources and As₄, Sb₄, triethylarsine (TEAs), and triethylstibine (TESb) as group V sources were obtained by measuring growth rates and composition variations obtained with different growth conditions. It was found that the use of Sb instead of As produced a substantial change in the MOMBE growth characteristics for the growth of GaSb and GaAs, in spite of using the same TEGa. The use of TEAs and TESb instead of As₄ and Sb₄, respectively, was found to change the growth rate variation of both the GaAs and GaSb with T(sub). In the growth of AlGaSb using TIBAl, TEGa, and Sb₄, the incorporation rate of Al was suppressed by the coexistence of TEGa on the growth surface in the low substrate temperature region, while that of Ga was hardly influenced by the TIBAl. I.S.

A92-40918

THE ELECTRICAL, OPTICAL AND CRYSTALLINE PROPERTIES OF GaAs:C GROWN BY GSMBE USING TMG AND ASH₃ FOR APPLICATION TO HBTS

A. SANDHU, T. NAKAMURA, H. ANDO, K. DOMEN, N. OKAMOTO, and T. FUJII (Fujitsu Laboratories, Ltd., Atsugi, Japan) (Chemical beam epitaxy and related growth techniques 1991; Proceedings of the 3rd International Conference /ICCBE-3/, Oxford, England, Sept. 1-5, 1991. A92-40901 16-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 120, no. 1-4, May 1992, p. 296-300. refs

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The electrical, optical, and crystalline properties of heavily carbon-doped p-type (100) GaAs:C epilayers grown by gas source molecular beam epitaxy using trimethylgallium and ArH₃ are described. It was found that, in the case of as-grown GaAs:C, the carbon was 100 percent electrically active. Results of photoluminescence (PL) measurements showed band-gap

shrinkage with increasing hole concentration. Annealing at 900 C caused significant decreases in the hole concentration, lattice contraction, and PL intensity. I.S.

A92-40919

HEAVILY CARBON-DOPED P-TYPE INGAAS BY MOMBE

E. TOKUMITSU, J. SHIRAKASHI, M. QI, T. YAMADA, S. NOZAKI, M. KONAGAI, and K. TAKAHASHI (Tokyo Institute of Technology, Japan) (Chemical beam epitaxy and related growth techniques 1991; Proceedings of the 3rd International Conference /ICCBE-3/, Oxford, England, Sept. 1-5, 1991. A92-40901 16-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 120, no. 1-4, May 1992, p. 301-305. refs

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Carbon-doped In(x)Ga(1-x)As layers (x = 0-0.96) were grown by metalorganic molecular beam epitaxy (MOMBE) using trimethylgallium (TMG), solid arsenic (As₄) and solid indium (In) as sources of Ga, As and In, respectively. The carrier concentration is strongly affected by growth temperature and indium beam flux. Heavy p-type doping is obtained for smaller In compositions. The hole concentration decreases with the indium composition from 0 to 0.8, and then the conductivity type changes from p to n at x = 0.8. Hole concentrations of 1.0 x 10¹⁹ and 1.2 x 10¹⁹ /cm³ are obtained for x = 0.3 and 0.54, respectively. These values are significantly higher than those reported on carbon-doped In(x)Ga(1-x)As by MBE. Preliminary results on carbon-doped GaAs/In(x)Ga(1-x)As strained layer superlattices are also discussed. Author

A92-40923

HILLOCK FORMATION OBSERVED IN MOMBE OF INGAAS GROWN ON A PATTERNED GAAS SUBSTRATE

S. GOTO, Y. MORISHITA, Y. NOMURA, Y. KATAYAMA (Optoelectronics Technology Research Laboratory, Tsukuba, Japan), and T. ISU (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) (Chemical beam epitaxy and related growth techniques 1991; Proceedings of the 3rd International Conference /ICCBE-3/, Oxford, England, Sept. 1-5, 1991. A92-40901 16-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 120, no. 1-4, May 1992, p. 382-388. refs

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InGaAs layers were grown by metalorganic molecular beam epitaxy on a mesa-etched (100) GaAs substrate. It is shown that, under specific growth conditions, hillocks comprised mostly of InAs could be formed in InGaAs layers at high substrate temperatures. The distribution of hillocks formed by using trimethylindium and metal Ga strongly depended on the width of the grooves. I.S.

A92-40924

LASER-ASSISTED CHEMICAL BEAM EPITAXY FOR SELECTIVE GROWTH

H. SUGIURA, R. IGA, and T. YAMADA (NTT, Optoelectronics Laboratories, Atsugi, Japan) (Chemical beam epitaxy and related growth techniques 1991; Proceedings of the 3rd International Conference /ICCBE-3/, Oxford, England, Sept. 1-5, 1991. A92-40901 16-76) Journal of Crystal Growth (ISSN 0022-0248), vol. 120, no. 1-4, May 1992, p. 389-394. refs

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A recent exciting development in the growth of compound semiconductors is the use of light to modify the film growth rate in the irradiation area. Ar(+) laser-assisted CBE of GaAs, InP, GaP, and InGaAs to generate various patterned films without lithography is reported. A linked-circle pattern is formed by laser beam scanning and a 0.85 micron pitch corrugation pattern formed by a holographic interference technique. Relationships between the growth rate and substrate temperature for the materials are compared. The mechanism of the growth rate enhancement is revealed to be photolytic decomposition of metalorganic molecules. In the case of InGaAs, laser irradiation above 500 C results in new phenomena of growth rate suppression and composition variation. Author

A92-41152

INFLUENCE OF CYCLIC LOADING AT ROOM TEMPERATURE ON THE CRITICAL CURRENT AT 4.2 K OF Nb3Sn SUPERCONDUCTING COMPOSITE WIRE

S. OCHIAI and K. OSAMURA (Kyoto University, Japan) Cryogenics (ISSN 0011-2275), vol. 32, no. 6, 1992, p. 584-590. refs (Contract MOESC-01050005)

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The influence of cyclic loading at room temperature on the critical current at 4.2 K of bronze-processed multifilamentary Nb3Sn superconducting composite wire was studied. After the first cycle, the critical current and upper critical magnetic field increased, reaching a maximum and then decreased with increasing applied stress. After the second and following cycles, the changes were small when the applied stress was not high enough to cause damage to the Nb3Sn. These results can be described well quantitatively by substituting the strain values of Nb3Sn calculated in this work into Ekin's scaling law for the strain effect. When the applied stress was high enough to cause damage to the Nb3Sn in the first cycle, the critical current decreased with increasing numbers of cycles.

Author

A92-41591

EFFECTS OF LIGHT EXPOSURE DURING ANODIZATION ON PHOTOLUMINESCENCE OF POROUS SI

TANEMASA ASANO, KATSUYA HIGA, SATOSHI AOKI, MASAYOSHI TONOUCHI, and TATSURO MIYASATO (Kyushu Institute of Technology, Izuka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L373-L375. refs

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Photoluminescence study has been carried out on porous Si which has been prepared from p-type Si wafers either by anodization under light illumination (photoanodization) or by anodization in the dark. It has been found that the photoanodization makes the luminescence peak wavelength shorter and the luminescence intensity stronger. As a result of these effects, visible red light luminescence has been reproducibly obtained. These effects have been found to be more pronounced when highly concentrated HF solutions are used for anodization. Scanning electron microscopy and Raman spectroscopy showed no distinct differences in microstructure or crystallinity between the photoanodized and in-dark anodized porous Si.

Author

A92-41594

ELECTRICAL AND MAGNETIC PROPERTIES OF THE HIGH-TC SUPERCONDUCTORS $Y(1-x)M(x)Ba_2Cu_3O(y)$ AND $Y(Ba(1-x)M(x))_2Cu_3O(y)$ ($M = Mg, Ca, Sr, Ba$)

YUKICHI TATSUMI, TAKEJI KEBUKAWA, YUTAKA MISAWA (Shinshu University, Nagano, Japan), and KATSUYUKI FUJIWARA (Nagano National College of Technology, Tokuma, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L392-L395. refs

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The superconducting state of $YBa_2Cu_3O(y)$ substituted at the II a group was investigated by X-ray powder diffraction, iodometric titration, electrical resistivity, and magnetization measurements. The T_c is shifted to low temperature by the substitution of Y or Ba from a heavy atom to light atom at $x = 0.1$, and depends on the ionic radius. In the results obtained from the magnetic hysteresis loop, it is interesting that, in the case of the substitution of Ca for $x = 0.1$, the magnetization for Y is larger than that for Ba with decreasing temperature, and the magnetization in the case of Ba for Y is rapidly lowered at $x = 0.1$.

Author

A92-41595

A NEW SUPERCONDUCTOR WITH $T_C = 47$ K IN THE Bi-Sr-Cu-O SYSTEM (NOMINAL COMPOSITION = $Bi_4Sr(8+x)Cu(5-x)O(y)$)

TOHRU DEN and TOSHIKI AIBA (Canon Research Center, Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L396-L398. refs

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A new superconductive bismuth cuprate, with a nominal composition of $Bi_4Sr(8+x)Cu(5-x)O(y)$, was discovered using resistivity and magnetization measurements. The onset transition temperatures of as-synthesized and He-annealed samples are 42 K and 47 K, respectively. This superconductive phase is very unstable at the synthesis temperature, and thus, changes into $Bi_4Sr_8Cu_5O(9+\alpha)$ and $Bi_2Sr_3Cu_2O(y)$ with prolonged calcination. Because of this instability, a single phase cannot be obtained. X-ray diffraction measurements indicate the existence of a new phase with a large-value peak of $d = 19.8$ Å.

Author

A92-41597

TWO-DIMENSIONAL EPITAXIAL GROWTH OF $Bi_2Sr_2CuO(x)$ ON TILTED $SrTiO_3(001)$ SUBSTRATES STUDIED BY REFLECTION HIGH ENERGY ELECTRON DIFFRACTION

TAKAYUKI ISHIBASHI, KANG-HO SONG, YOSHITAKA OKADA, and MITSUO KAWABE (Tsukuba, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4A, April 1, 1992, p. L406-L409. Research supported by MOESC. refs

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Growth modes of $Bi_2Sr_2CuO(x)(2201)$ thin epitaxial films have been studied by coevaporation technique in molecular beam epitaxy (MBE) on tilted $SrTiO_3(001)$ substrates with angles of 2, 4, and 6 deg toward (110 deg). Observation of (RHEED) intensity oscillations means that the growth proceeds by 2D mode. After continued growth over 1.2 nm, clear RHEED patterns of the known superstructures were observed. For the 2-deg tilted substrates, the RHEED patterns indicated that most of the films consisted of untwinned structure with small portions of twinned structure. For 4 and 6-deg tilted substrates, however, the RHEED patterns of untwinned structures were observed. Furthermore for 6-deg-tilted substrates, the RHEED patterns showed separated streaks, arising from the periodic step structures, which was not originally observed on the substrate surface.

Author

A92-41719

A NEW COPPER OXIDE SUPERCONDUCTOR CONTAINING CARBON

K. KINOSHITA and T. YAMADA (NTT, Basic Research Laboratories, Musashino, Japan) Nature (ISSN 0028-0836), vol. 357, no. 6376, May 28, 1992, p. 313-315. refs

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The synthesis is reported, at 50 atm oxygen partial pressure, of superconducting $(Ba(x)Sr(1-x))_2Cu(1+y)O(2+2y+\delta)(CO_3)(1-y)$ ($x = 0.4-0.65$, y roughly 0.1), with T_c (onset) up to about 40 K and zero resistance at up to about 26 K. The crystal structure contains CuO_2 sheets alternating with $(Ba(x)Sr(1-x))_2Cu(y)O(2y+\delta)(CO_3)(1-y)$ slabs, which serve as charge reservoir layers. Substitution of about 10 percent copper for carbon in the slabs introduces holes into the CuO_2 sheets, making the compound superconducting.

C.D.

A92-42105

IN-PROCESS ELLIPSOMETRIC MONITORING OF DIAMOND FILM GROWTH BY MICROWAVE PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION

YASUAKI HAYASHI (ULVAC Japan, Ltd., Tsukuba), WILLIAM DRAWL, R. W. COLLINS, and RUSSELL MESSIER (Pennsylvania State University, University Park) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 23, June 8, 1992, p. 2868-2870. Research supported by Diamond and Related Materials Consortium. refs (Contract NSF DMR-89-01031)

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In-process monitoring of diamond film growth was performed with near-IR ellipsometry (1550). The trajectories in the ellipsometric parameters (ψ , Δ) differ according to the method of substrate pretreatment and the CO/H_2 gas ratio used in the microwave plasma-enhanced CVD process. The nucleation density determined from ellipsometry shows qualitative agreement with that from SEM performed after deposition. The rate at which nuclei develop is also monitored, and the observed induction time is shorter for conditions leading to higher nucleation density.

Author

A92-42130**SITE OCCUPANCY AND ANHARMONIC THERMAL VIBRATION IN SUPERCONDUCTOR $\text{Ti}_2\text{CaBa}_2\text{Cu}_2\text{O}_8$**

SATOSHI SASAKI (Tokyo Institute of Technology, Yokohama, Japan), KENICHI KAWAGUCHI, and MASAO NAKAO (Sanyo Electric Co., Ltd., Tsukuba Research Center, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L467-L470. refs

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Single-crystal X-ray intensity data have been used to characterize the crystal structure of the high temperature superconducting oxide $\text{Ti}_2\text{CaBa}_2\text{Cu}_2\text{O}_8$, and XRD is used to determine the exact formula of the compound. Difference-Fourier syntheses indicate anharmonic thermal vibration for the Ti and Ba atoms; this is describable by a Gramm-Chalier series expansion of the Gaussian density function. O.C.

A92-42131**LOW-TEMPERATURE SN-119-MOESSBAUER STUDY OF SUPERCONDUCTING $\text{Bi}_4\text{Sr}_{3.5}\text{Ca}_{2.5}\text{Cu}_4\text{Sn}_{0.015}\text{O}_{16-y}$ CERAMIC (2212 PHASE)**

TETSUAKI NISHIDA (Kyushu University, Fukuoka, Japan), MOTOMI KATADA (Tokyo Metropolitan University, Hachioji, Japan), NORIO MIURA, YUICHI DESHIMARU, NOBORU YAMAZOE (Kyushu University, Kasuga, Japan), YASUKUNI MATSUMOTO (Fukuoka University, Japan), and YOSHIMASA TAKASHIMA (Kyushu University, Fukuoka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L471-L473. Research supported by MOESC. refs

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The Sn-119-Moessbauer spectra of superconducting $\text{Bi}_4\text{Sr}_{3.5}\text{Ca}_{2.5}\text{Cu}_4\text{Sn}_{0.015}\text{O}_{16-y}$ ceramic (2212 phase, T_c , 77 K), measured between 298 K and 7 K, consist of singlet peaks of $\text{Sn}(4+)$ with the deltas and Gammas of -0.01-0.07 and 1.05-1.27 mm/s, respectively. The $\ln A$ (absorption area)-vs.- T plot shows that the recoil-free fraction f increases with decreasing temperature, and that the Debye and Einstein temperatures are 340 and 185 K, respectively. The $\Theta(D)$ of 340 K suggests that the $\text{Sn}(4+)$ is in the BiO_5 pyramids. The $\ln A$ shows a 'normal' lattice vibration, probably because of the long Cu-O(3) distance and the displacement of O(3). Author

A92-42132**LATTICE DYNAMIC STUDY OF SEMICONDUCTING $\text{Bi}_2\text{Sr}_2\text{Y}(\text{Cu}_{1-x}\text{Sn}_x)_2\text{O}_y$ BY SN-119-MOESSBAUER SPECTROSCOPY**

HIROMI ISHII (Kyushu University, Kasuga, Japan), TETSUAKI NISHIDA (Kyushu University, Fukuoka, Japan), MOTOMI KATADA (Tokyo Metropolitan University, Hachioji, Japan), and TAKAFUMI AOMINE (Kyushu University, Fukuoka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L474-L476. refs

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The Sn-119-Moessbauer spectra of semiconducting $\text{Bi}_2\text{Sr}_2\text{Y}(\text{Cu}_{1-x}\text{Sn}_x)_2\text{O}_y$ ceramic consist of singlet peaks (δ : 0.02-0.09 mm/s; Γ : 1.09-1.20 mm/s) in the temperature range 298 K-7 K. The absorption area (A) increases almost linearly with decreasing temperature, indicating the 'normal' Sn-site vibration expressed by the 'combined Debye and Einstein model'. A comparison of the theoretical curve to the $\ln A$ -vs- T and δ -vs.- T plots yields the Debye and Einstein temperatures of 370 and 200 K, respectively. These results suggest that the $\text{Sn}(4+)$ is present in the BiO_4 planars, constituting $\text{Bi}(\text{Sn})\text{O}_5$ pyramids. Author

A92-42134**ELECTRON DIFFRACTION AND HIGH-RESOLUTION ELECTRON MICROSCOPY STUDY ON THE STRUCTURE OF SOLID C_{60}**

TAKASHI ISHIGURO and YOSHIHIKO HIROTSU (Nagaoka University of Technology, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992,

p. L481-L483. Research supported by MOESC. refs

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Electron diffraction and HREM are presently employed to investigate the structure of solid C_{60} . The plan-view and sectional observations of platelike specimens exhibit an FCC structure. Weak reflections previously interpreted as HCP are presently determined to be consequences of the Ewald sphere effect cutting of streaked-intensity regions due to the FCC structure's stacking disorder. O.C.

A92-42135**STUDY OF LUMINESCENT REGION IN ANODIZED POROUS SILICONS BY PHOTOLUMINESCENCE IMAGING AND THEIR MICROSTRUCTURES**

NOBUAKI NOGUCHI, IKUO SUEMUNE, MASAMICHI YAMANISHI (Hiroshima University, Higashihiroshima, Japan), G. C. HUA, and NOBUO OTSUKA (Purdue University, West Lafayette, IN) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L490-L493. refs

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The luminescent region in anodized porous silicon was examined by means of a photoluminescence imaging technique. It was found for the first time that the luminescence in the visible region originates from the topmost surface layer. This was confirmed not only by the surface photoexcitation but also by the excitation of the cleaved edge. This topmost surface layer does not show any diffraction spots with TEM and is regarded as an amorphous layer. The microstructure of this layer observed by means of SEM consisted of microparticles with the dimensions of 5-30 nm, where the lower dimension is limited by the SEM resolution. Author

A92-42136**PHOTOIRRADIATION EFFECT ON PHOTOLUMINESCENCE FROM ANODIZED POROUS SILICONS AND LUMINESCENCE MECHANISM**

IKUO SUEMUNE, NOBUAKI NOGUCHI, and MASAMICHI YAMANISHI (Hiroshima University, Higashihiroshima, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L494-L497. refs

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The photoirradiation effect on photoluminescence (PL) from anodized porous silicon was studied. Although PL from Si anodized in artificial light decreased with photoirradiation, PL from Si anodized in the dark was found to increase with photoirradiation in air. The main factor for the photoirradiation effect was attributed to oxidation in the surface layer by transmission infrared spectroscopy. During the temporal spectral change in the Si samples anodized in the dark, discrete PL peaks were observed. These PL peaks were excellently modeled by a quantum size effect. The observed blue shift of the PL spectra is interpreted to be due to the reduction of the microparticle size in the topmost amorphous layer with oxidation. Author

A92-42137**SCANNING ELECTRON MICROSCOPE IMAGES OF C_{60} WHISKERS**

YOSITAKA YOSIDA (Iwaki-Meisei University, Iwaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L505-L507. refs

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Filamentary crystal growth of the fullerene C_{60} has been achieved. SEM images of filamentary crystals, so-called whiskers, revealed differences in the dimensions and the nature of surfaces depending on their growth temperatures. SEM images of the top surface of the whisker grown at 80 C revealed that the crystal habit is an octahedron and that the whisker axis is parallel to the fourfold rotational symmetry axis. Author

A92-42138**LATTICE PARAMETER CONTROL OF EPITAXIALLY GROWN HEXAGONAL LaF_3 FILMS ON $\text{GaAs}(111)$ SUBSTRATES BY INCORPORATION OF ORTHORHOMBIC YF_3**

76 SOLID-STATE PHYSICS

KOUJI AIZAWA, HERVE RICARD, and HIROSHI ISHIWARA (Tokyo Institute of Technology, Yokohama, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L508-L510. refs
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A92-42139

EPITAXIAL SrTiO₃ THIN FILMS GROWN BY ArF EXCIMER LASER DEPOSITION

TAKASHI HIRANO, TATSUHIKO FUJII (Osaka University, Toyonaka, Japan), KOZO FUJINO (Nippon Sheet Glass Co., Ltd., Itami, Japan), KEN SAKUTA, and TAKESHI KOBAYASHI (Osaka University, Toyonaka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L511-L514. Research supported by MOESC. refs
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SrTiO₃ (STO) thin films were prepared by an ArF excimer laser deposition method. At the growth temperature of 630 C, the natural orientation of STO was significantly changed from (111) to (100) and (110). The ratio of X-ray diffraction intensities (100)/(200) was closest to the ideal value when grown at 660 C, resulting in minimized disorder of atomic arrangement. Epitaxial STO films were obtained on STO(100) and MgO(100) substrates, and on an YBaCuO(001) epitaxial film. They showed resistivity in excess of $5 \times 10 \exp 10$ ohm/cm and dielectric constant as high as 140 sub epsilon 0 at room temperature. The maximum dielectric constant of 440 sub epsilon 0 was obtained at 40 K. Author

A92-42140

FINE STRUCTURE OF POROUS Si WITH VISIBLE PHOTOLUMINESCENCE

KIYOKAZU NAKAGAWA, AKIO NISHIDA, TOSHIKAZU SHIMADA (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Japan), HIRONARU YAMAGUCHI, and KINYA EGUCHI (Hitachi, Ltd., Production Engineering Research Laboratory, Yokohama, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 4B, April 15, 1992, p. L515-L517. refs
Copyright

Porous Si formed by anodization is studied by means of high-resolution scanning electron microscopy, optical microscopy, microphotoluminescence spectroscopy and micro-Raman spectroscopy. Surface morphologies of porous Si films are varied by changing the anodization conditions. High-resolution scanning electron microscopy measurements show that in all these films, porous Si fine structures of visible photoluminescent regions, which are confirmed with optical microscopy and microphotoluminescence spectroscopy, are composed of particlelike structure of various sizes from several nm to several tens of nm. The peak of the Raman spectrum from the particlelike structure is shifted to lower energy and is wider than that for bulk Si, possibly due to lattice expansion around large surface fractions. Visible photoluminescence in porous Si is not due to carrier confinement in quantum wires, but is probably due to carrier confinement in this structure. Author

A92-42385

TRANSIENT LIGHT-INDUCED ESR INVESTIGATIONS OF THE ROLE OF HYDROGEN IN THE STABILITY OF a-Si:H

ZAKI M. SALEH, HISAKI TARUI, KUNIMOTO NINOMIYA, TSUYOSHI TAKAHAMA, YUKIO NAKASHIMA, NOBORU NAKAMURA, HISAO HAKU, KENICHIRO WAKISAKA, MAKOTO TANAKA, SHINYA TSUDA (Sanyo Electric Co., Ltd., Functional Materials Research Center, Hirakata, Japan) et al. Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 995-998. Research supported by MITI. refs
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The role of hydrogen in the stability of a-Si:H was investigated, using transient light-induced electron spin resonance (LESr) at 120 K to examine the relative intensities of the broad and the narrow components of the LESr line shape in as-deposited and in light-soaked states. It was found that dramatic changes occur in the LESr upon prolonged light-soaking, suggesting that hydrogen defects (Si-H₂ or clustered Si-H bonds) play an important role in

these changes. An explanation is proposed of the possible optical excitations and defects conversion as the mechanism leading to these changes. I.S.

A92-42386

PREPARATION AND SUPERCONDUCTING PROPERTIES OF Bi-Pb-Sr-Ca-Cu-O FILMS (T_c = 106 K) BY THE DIPPING-PYROLYSIS PROCESS

TAKAAKI MANABE, TATSUO TSUNODA, WAKICHI KONDO, YUJI SHINDO, SUSUMU MIZUTA, and TOSHIYA KUMAGAI (National Chemical Laboratory for Industry, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1020-1025. refs
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The procedure for preparing superconducting Bi-Pb-Sr-Ca-Cu-O (with 2223 as the major phase) on MgO (100) substrates by the dipping-pyrolysis process is described. In this procedure, metal naphthenates were used as starting materials, and a combination of Pb substitution and Bi-Pb-Sr-Ca-Cu-O pellet techniques was used. The properties of the films included a T_c of 106 K and a J_c (77 K) of $2 \times 10 \exp 3$ A/sq cm. I.S.

A92-42387

MAGNETIC SHIELDING BY SUPERCONDUCTING Y-Ba-Cu-O PREPARED BY THE MODIFIED QUENCH AND MELT GROWTH (QMG) PROCESS

TSUTOMU SASAKI, MASAMOTO TANAKA, MITSURU MORITA, KATSUYOSHI MIYAMOTO, and MISAO HASHIMOTO (Nippon Steel Corp., Advanced Materials and Technology Research Laboratories, Kawasaki, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1026-1032. refs
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Magnetic shielding capability has been investigated on Y-Ba-Cu-O crystals prepared by the modified QMG process at 77 K and 4.2 K. Overall critical current densities in large single-grained specimens were estimated to be about 1000 A/sq cm based on the Bean model in order to predict shield effect. At 77 K, a single grain cylinder shields the inside up to about 0.2 T of the external field, and this value is the highest among all the values reported so far for tubes fabricated of oxide superconductors. A comparison between shielding characteristics of a single grain and those of a polygrain demonstrated that weaklinking high-angle grain boundaries should be eliminated for high field shielding. Lorentz force, flux creep, and flux jump are discussed. Author

A92-42388

ENLARGEMENT OF KINETIC INDUCTANCE OF NBN SUPERCONDUCTING THIN FILMS FOR DEVICE APPLICATIONS

MOHAMMAD S. HOSSAIN, KEIJI YOSHIDA, KEISUKE KUDO, KEIJI ENPUKU, and KAORU YAMAFUJI (Kyushu University, Fukuoka, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1033-1038. refs
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Two efficient methods are described for the enlargement of kinetic inductance of Nbn superconducting thin film by utilizing stoichiometry effect and geometry effect. The effect of changing stoichiometry of the film was achieved by increasing the concentration of N₂ in the sputter gas mixture of Ar and N₂, and the geometry effect was achieved by decreasing the film thickness in an ultrathin regime. The inductance of the junction was evaluated using the Fiske current steps method, demonstrating that the specific kinetic inductance can be increased by both effect and the enlargement can be enhanced by combining both effects. I.S.

A92-42392

INFLUENCE OF CONTAMINATION IN REPEATED DEPOSITIONS ON THE PROPERTIES OF DIAMOND FILMS

ICHIRO WATANABE, TAKASHI YAMASHITA, and MASATO SUGIMOTO (Kanazawa University, Japan) Japanese Journal of

Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1187, 1188. refs

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The effect of contamination inherent in the reaction system on the growth rate and the properties of diamond films grown by microwave plasma CVD was investigated in experiments where diamond films were synthesized from a mixture of ethyl alcohol and hydrogen using the CVD method described by Yamaguchi et al. (1989). Results showed that the contamination, consisting of amorphous carbon with sp² and sp³ bonds and diamond, resulted in a decreased growth rate of diamond films during repeated deposition, but did not affect the properties of the films, as characterized by SEM, Raman spectroscopy, and ESR. I.S.

A92-42393

STRESS-FREE GAAS ON SI BY LASER PULSE IRRADIATION
MASAYOSHI UMENO, TETSUO SOGA, and TAKASHI JIMBO
(Nagoya Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 4, April 1992, p. 1189, 1190. refs

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A novel method to relieve the stress in GaAs on a Ge-coated Si substrate using YAG laser pulse irradiation (the wavelength is 1.064 micron) is described. The stress decreases with increasing number of shots or shortening pulse width while keeping pulse energy per shot constant. The residual stress in the GaAs on Si after irradiation of 5 shots of the laser pulse (the pulse width is 2 ns and pulse energy is 0.36 J/pulse) is almost zero. Author

A92-42558

**ELASTIC ANOMALY OF YBa₂Cu₃O_{7-x}
SUPERCONDUCTORS CONTAINING DIFFERENT OXYGEN CONTENTS**

P. G. GALLIANO, N. SOGA, and K. HIRAO (Kyoto University, Japan) Journal of Materials Science (ISSN 0022-2461), vol. 27, no. 10, May 15, 1992, p. 2623-2626. refs

Copyright

Four samples of YBa₂Cu₃O_{7-x} with different values of x were prepared and characterized, and their elastic properties from 80 K to room temperature were investigated. It was found that an anomalous softening of the elastic moduli G, K, and E at temperatures slightly higher than T_c appeared only on the specimens with the superconducting orthorhombic phase. As the value of x became small and the transition width Delta T_c became narrower, the softening became remarkable. The elastic constants also showed a thermal hysteresis at low temperatures. Relationships between this behavior and proposed structural and domain changes are discussed. Author

A92-42835

EPITAXIAL GROWTH OF DIAMOND FROM THE GAS PHASE
YOICHIRO SATO (National Institute for Research in Inorganic Materials, Tsukuba, Japan), ISAMU YASHIMA (Mitsui Mining Co., Ltd., Tochigi, Japan), HIDEKI FUJITA (Onoda Cement Co., Ltd., Ceramics Research Laboratory, Tokyo, Japan), TOSHIHIRO ANDO, and MUTSUOKAZU KAMO (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 371-376. refs

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Epitaxial growth of diamond has been attempted on (100) face of diamond and on nickel and cobalt by microwave plasma-enhanced vapor deposition from gaseous mixtures of methane and hydrogen. Epitaxial growth on (100) face of diamond was performed under a relatively high methane concentration where diamond whiskers can grow. The films proved to be of high quality, as assessed by Raman spectroscopy. Preliminary studies of deposition on nickel and cobalt showed that epitaxial growth of diamond on these substrates is feasible. Author

A92-42836

SOME OBSERVATIONS OF NUCLEATION SITES IN DIAMOND GROWTH BY PLASMA CVD

S. YUGO, A. IZUMI, T. KANAI, T. MUTO, and T. KIMURA (University of Electro-Communications, Chofu, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 385-389. refs

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Scratches caused on the silicon surface by the ultrasonic treatment and the following etching in hydrogen plasma and in acid solution were observed with scanning tunneling microscope. Thereafter, diamond nuclei were generated on these substrate surfaces by the conventional microwave plasma CVD. The correlation between the shape of scratches and generation of diamond nuclei was studied. It was found that scratches with the depth below 5 nm suppressed the nucleus generation, whereas smooths and V-shaped scratches with the depth of 5-15 nm acted as effective nucleus centers. These shape and size of scratches may be effective to gather carbon atoms rapidly enough to form critical nuclei against the reevaporation in the plasma CVD of diamond. Author

A92-42841

MICROFABRICATION OF DIAMOND FILMS - SELECTIVE DEPOSITION AND ETCHING

K. KOBASHI, A. NAKAUE (Kobe Steel, Ltd., Electronics Research Laboratory, Japan), JEFFREY T. GLASS (North Carolina State University, Raleigh), and IAN M. BUCKLEY-GOLDER (AEA Technology, Harwell Laboratory, England) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 419-424. Research supported by New Energy and Industrial Technology Development Organization of Japan. refs

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Two different methods of selected-area deposition were developed by treating Si substrates by means of reactive-ion etching and amorphous-silicon masking, and it was shown that a few-microns wide pattern of diamond film was formed in both cases. A selective nucleation was also attained on Si substrates by these methods. Furthermore, it was demonstrated that a selective deposition of new diamonds on a diamond film can be attained by the ASM method. The etching of diamond films was carried out by the electron-beam assisted plasma etching method, and as a result, a diamond film pattern of about 10-microns wide was formed. These methods will be useful for the future application of diamond films to microelectronic devices and sensors. Author

A92-42847

DEPOSITION OF DIAMOND CRYSTAL AT SUBSTRATE TEMPERATURE LOWER THAN 500 C

K. BANDO (Nichia Kagaku Kogyo Co., Tokushima, Japan), K. KAMO, T. ANDO, and Y. SATO (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 467-472. refs

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Study of nucleation and growth of diamond from the gas phase was attempted at substrate temperatures ranging from 500 C to 280 C, using microwave plasma-assisted chemical vapor deposition. In order to study the growth stage, cuboctahedral crystals about 5 microns deposited on silicon substrate over 800 C were used as seed crystals. In the temperature range of 500 C-300 C, growth rate of the (100) face was found to be greater than that of the (111) face. Growth rate decreased by a factor of 15 in going from 500 C to 300 C. Density and rate of nucleation on silicon substrates in this temperature range were invariably found to be much lower than those observed at temperatures of 800 C-900 C. Increase in carbon content in the gas phase resulted in increase in nucleation density, and formation of loosely bound spherical diamonds of

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submicron size, rather than films, has been observed in this temperature range. Author

A92-42848

MORPHOLOGY AND GROWTH PROCESS OF SINGLE CRYSTALLINE DIAMOND GROWN BY MICROWAVE PLASMA CVD IN THE CO-H₂ SYSTEM

HIDEAKI ITOH, TADASHI NAKAMURA, HIROYASU IWAHARA (Nagoya University, Japan), and HIROMICHI SAKAMOTO (Sigma Coating Engineering, Kyoto, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 479-484. refs
Copyright

Single crystalline diamond was grown by microwave plasma CVD using a reactant gas mixture of the CO-H₂ system. Spontaneously nucleated single crystals of diamond were deposited on silicon (100) wafer under conditions of 500 W microwave power (substrate temperature: 850-950 C), pressure of 30-60 Torr, and total flow rate of 200 ml/min. Euhedral diamond crystals having diameters of 5-20 microns were grown for 5 h under total pressure of less than 60 Torr, and at CO concentrations of less than 10 vol pct. The growth of (111) plane tended to prevail with increasing CO concentration. Variations of morphologies and growth process of coarse seed crystals of natural diamond (grain size of about 200 microns), which were placed on a silicon substrate, were observed at given intervals of reaction time under the above growth conditions. Author

A92-42849

CRYSTAL GROWTH BY DC PLASMA JET CVD

KEN-ICHI SASAKI, K. KURIHARA, and M. KAWARADA (Fujitsu Laboratories, Ltd., Atsugi, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 485-490. refs
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A unique feature of dc plasma jet CVD to be oblique growth was discovered. Two parameters affecting oblique growth, methane concentration and chamber pressure were checked. Increasing the methane concentration or decreasing the chamber pressure increases the density of the diamond precursor. This density appears important to oblique growth. It was also found that the mechanical strength of the obliquely grown film depends on the direction of crystal growth. Author

A92-42852

DEPOSITION OF LARGE DIAMOND PARTICLES IN PREMIXED OXYACETYLENE FLAME

YOSHIKI MORINISHI and TOMIO SUZUKI (Kobe Steel, Ltd., Mechanical Engineering Research Laboratory, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 517-522. refs
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Diamonds are synthesized in an oxyacetylene flame of a cutting/welding torch under atmospheric conditions. The optimum conditions for producing coarse diamond particles are investigated by varying the distance between the torch nozzle and the substrate from 1 mm to 6 mm. The substrate temperature is controlled by using a water or an air-cooled holder. Single crystalline diamond particles of about 300 microns in diameter and polycrystalline diamond particles of about 500 microns are produced on Si substrates. Author

A92-42854

GROWTH AND CHARACTERIZATION OF HIGH QUALITY CVD DIAMONDS

YOICHIRO SATO (National Institute for Research in Inorganic Materials, Tsukuba, Japan), CHIEMI HATA (Hoya Corp., Tokyo, Japan), TOSHIHIRO ANDO, and MUTSUKAZU KAMO (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN:

New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 537-548. refs

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It is suggested that defects unique to CVD diamonds are due to sp² carbons, the fraction of which depends critically on deposition conditions. The unique properties of sp² carbon assemblies are discussed based on model organic compounds, in relation to the Raman spectra, light absorption, and extended defects. Characterization of high quality CVD diamonds is presented and factors with critically affect crystal quality are summarized. Author

A92-42857

HIGH RESOLUTION TEM OBSERVATIONS OF CVD DIAMOND FILMS

NORIBUMI KIKUCHI, Y. OHSAWA, Y. TAMOU, H. ETO, and H. YAMASHITA (Mitsubishi Metal Corp., Central Research Institute, Omiya, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 567-574. refs
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Diamond films synthesized by hot filament CVD with CH₄ concentrations of 0.5, 1, and 2 percent were studied using HRTEM. Raman spectroscopy measurements showed broad peaks of amorphous carbon in all samples and its intensity increased with increasing CH₄ concentrations. HRTEM images show many planar defects consisting of twins and stacking faults which increased with CH₄ concentration. In the low CH₄ concentrations these defects consist mainly of twin stacking faults and highly disordered regions which exist at the cross points of twin boundaries. The diamond film prepared from 2 percent CH₄ is shown to consist of fine grains of crystalline diamond which contain many defects. No amorphous carbon phase was detected in diamond films by HRTEM observations. These results indicate that amorphous carbon peaks of Raman spectroscopy in CVD diamond films are mainly due to grain boundaries of polycrystalline diamond. A.O.

A92-42867

SIMS ANALYSIS OF EPITAXIALLY GROWN CVD DIAMOND

MUTSUKAZU KAMO (National Institute for Research in Inorganic Materials, Tsukuba, Japan), HISAYOSHI YURIMOTO (Tsukuba, University, Japan), TOSHIHIRO ANDO, and YOICHIRO SATO (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 637-641. refs
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Qualitative analysis of diamond films epitaxially grown on diamond substrates by a microwave plasma method has been performed using a secondary ion mass spectrometer. Data obtained revealed that they are terminated with hydrogen phosphorous atoms doped in diamond, which suggests that a greater part of phosphorous atom in diamond does not serve as a donor center. O.G.

A92-42915

EPITAXIAL GROWTH OF CBN CRYSTAL ON DIAMOND

HARUHIKO SEI (Toshiba Tungaloy Co., Kawasaki, Japan), MINORU AKASHI, HISAO KANDA, TOSHIKAZU OSAWA, and SHINOBU YAMAOKA (National Institute for Research in Inorganic Materials, Tsukuba, Japan) IN: New diamond science and technology; Proceedings of the 2nd International Conference, Washington, DC, Sept. 23-27, 1990. Pittsburgh, PA, Materials Research Society, 1991, p. 1057-1062. refs
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Experiments on crystal growth of cBN on diamond were successfully carried out in Li₃BN₂ solvent by using a single crystal diamond as a seed in a temperature gradient method at a pressure of 5.5 GPa and a temperature of about 1700 C. From a single

crystal X-ray diffraction method, it was confirmed that the crystal faces and directions of the grown crystal were identical with those of the seed, showing that cBN grew epitaxially on the seed. The cleaved face was (111), the same as that of diamond, where a tightly bonded boundary between cBN and diamond was clearly seen because of the difference of the cleavage behavior of the two substances. The grown crystal exhibited more complicated morphology despite simple morphology of the seed crystal.

Author

A92-43476

FLOATING ZONE CRYSTAL GROWTH AND PHASE EQUILIBRIA - A REVIEW

SHIGEYUKI KIMURA and KENJI KITAMURA (National Institute for Research in Inorganic Materials, Tsukuba, Japan) American Ceramic Society, Journal (ISSN 0002-7820), vol. 75, no. 6, June 1992, p. 1440-1446. refs

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The thermal-imaging floating zone technique can be used to grow crystals of yttrium iron garnet aluminum-doped yttrium orthoferrite and magnetite, which represent peritectic compounds, solid-solution crystals, and atmosphere-sensitive materials, respectively. The reactions involved in floating zone crystal growth are explained on the basis of phase diagrams. A review of crystal growth reports, including unpublished findings by the present authors, demonstrates how the crystallization processes, the reaction with the ambient atmosphere, and the composition variation in the obtained crystals can be explained or controlled on the basis of phase equilibrium. The floating zone technique is applicable to a variety of materials and remains a handy tool for materials research; however, its industrial application may be limited.

Author

A92-43492

SIMULTANEOUS THERMOGRAVIMETRY AND EVOLVED-GAS ANALYSIS OF YBA₂CU₃O₇ AND LABA₂CU₃O₇ SUPERCONDUCTORS

TAKAHIRO WADA, HISAO YAMAUCHI, and SHOJI TANAKA (International Superconductivity Technology Center, Tokyo, Japan) American Ceramic Society, Communications (ISSN 0002-7820), vol. 75, no. 6, June 1992, p. 1705-1707. Research supported by New Energy and Industrial Technology Development Organization. refs

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Results are presented from concurrent thermogravimetry (TG) an evolved-gas analysis (EGA) performed on YBa₂Cu₃O(7-z) and LaBa₂Cu₃O(7-z) superconductors. The evolved O₂ and CO₂ gases were monitored by quadruple mass spectrometer. Results showed that CO₂ gas began to evolve from YBa₂Cu₃O(7-z) at 543 C and from LaBa₂Cu₃O(7-z) at 692 C (although the X-ray diffraction patterns of these samples did not disclose the presence of an impurity phase containing a carbonate group). I.S.

A92-43571

COHERENCE PEAKS OF NMR AND DYNAMIC CONDUCTIVITY IN ANISOTROPIC SUPERCONDUCTORS

FUSAYOSHI J. OHKAWA (Hokkaido University, Sapporo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 4, April 1992, p. 1157-1160. refs

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In anisotropic superconductors, the coherence peaks appear differently in the nuclear magnetic relaxation rate, 1/T₁, and the homogeneous dynamic conductivity, sigma(omega). The peak appears in sigma(omega). However, 1/T₁ shows no peak but rapid reduction just below critical temperature, if it is mainly due to antiferromagnetic spin fluctuations. The feature is consistent with recent measurements of YBa₂Cu₃O₇.

Author

A92-43573

VARIATION OF PHYSICAL PROPERTIES OF BI(1.6)PB(0.5)SR(1.9-Y)LA(Y)CU(1.05)O(Z) WITH THE LA-CONCENTRATION Y ACROSS THE SUPERCONDUCTING-NONSUPERCONDUCTING METAL BOUNDARY

SHUKICHI TANAKA, MASAFUMI SERA, MASATOSHI SATO (Nagoya University, Japan), and HIDESHI FUJISHITA (Kanazawa University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 4, April 1992, p. 1271-1276. Research supported by MOESC and Mazda Foundation. refs

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A92-43574

ON SUPERCONDUCTING DOUBLE TRANSITION IN A HEAVY FERMION MATERIAL UPT(3)

MASA-AKI OZAKI (Niihama National College of Technology, Japan) and KAZUSHIGE MACHIDA (Okayama University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 4, April 1992, p. 1277-1286. refs

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A92-43575

CU-63(2) NUCLEAR SPIN-SPIN RELAXATION IN YBA₂CU₃O(6.98), YBA₂(CU-63)3O(7-DELTA), AND YBA₂CU₄O₈

YUTAKA ITOH, HIROSHI YASUOKA, YOKO FUJIWARA, YUTAKA UEDA (Tokyo, University, Japan), TAKATO MACHI, IZUMI TOMENO, KEISHI TAI, NAOKI KOSHIZUKA, and SYOJI TANAKA (International Superconductivity Technology Center, Tokyo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 4, April 1992, p. 1287-1298. Research supported by MOESC. refs

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The temperature dependence of the transverse relaxation rate in the planar Cu-63(2) nuclear spins in the c-axis oriented YBa₂Cu₃O(6.98), Cu-63 enriched YBa₂(Cu-63)3O(7-delta), and YBa₂Cu₄O₈ is measured using the nuclear quadrupole resonance spin-echo technique. It is found that in the framework of the nuclear spin-spin relaxation experiments the high-temperature superconductivity seems to exhibit the d-wave pairing, which supports the antiferromagnetic spin-fluctuation mechanism. O.G.

A92-45645

PREPARATION OF SUPERCONDUCTING BA₂YCU₃O(7-Y)-AG COMPOSITE FILMS ON SAPPHIRE BY THE DIPPING PYROLYSIS PROCESS

T. MANABE, W. KONDO, S. MIZUTA, and T. KUMAGAI (National Chemical Laboratory for Industry, Tsukuba, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 60, no. 26, June 29, 1992, p. 3301-3303. refs

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Superconducting Ba₂YCu₃O(7-y)(BYCO)-Ag composite films were prepared on sapphire substrates without a buffer layer by the dipping pyrolysis process. Prefired films of a BaCO₃-Y₂O₃-CuO-Ag mixture (Ba:Y:Cu:Ag = 2:1:3:0.2 in molar ratio) were heat treated at 740 C under a low oxygen partial pressure followed by O₂ annealing at 450 C. The resulting 0.8-1.8-micron thick films showed high superconducting transition temperatures of 88-89 K.

Author

A92-45943

EXPERIMENTAL AND CALCULATIONAL STUDY ON DIAMOND GROWTH BY AN ADVANCED HOT FILAMENT CHEMICAL VAPOR DEPOSITION METHOD

EICHI KONDOH, TOMOHIRO OHTA, TOHRU MITOMO, and KENNICH OHTSUKA (Kawasaki Steel Corp., Technical Research Div., Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 2, July 15, 1992, p. 705-711. refs

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An advanced hot-filament chemical-vapor deposition (AHF-CVD) which enables independent control of CVD parameters was performed to investigate the effect of each CVD parameter upon

diamond growth. The simple configuration of this AHF-CVD system allows modeling as a 1D plug-flow reactor. Gas-phase chemical reactions were modeled by taking into account the temperature distribution between the filament and the substrate to assess the role of such chemical species as hydrogen atom and methyl radical in diamond growth. A comparison between the experimental and calculated results strongly suggests that the methyl radical is a promising diamond precursor in a system using CH₄-H₂ as the source gas, and that a well-crystallized diamond would be deposited under the conditions of a large proportion of hydrogen atoms with respect to the precursor. Author

A92-46341**PHOTOLUMINESCENCE OF POROUS SI, OXIDIZED THEN DEOXIDIZED CHEMICALLY**

A. NAKAJIMA, T. ITAKURA, S. WATANABE, and N. NAKAYAMA (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 1, July 6, 1992, p. 46-48. refs Copyright

The change in photoluminescence spectra of porous Si when it is oxidized then deoxidized chemically is examined. After both steps, photoluminescence shifted to higher frequencies and increased in intensity. These shifts to higher frequencies indicate the photoluminescence is a result of the quantum size effect. Moreover, the increase in photoluminescence intensity after oxidation suggests that termination by hydrogen on the porous Si surface does not always play a key role in the photoluminescence mechanism. Author

A92-46347**SYNCHROTRON RADIATION-ASSISTED SILICON HOMOEPITAXY AT 100 C USING Si₂H₆/H₂ MIXTURE**

YASUO NARA, YOSHIHIRO SUGITA, KEI HORIUCHI, and TAKASHI ITO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 1, July 6, 1992, p. 93-95. refs Copyright

Epitaxial silicon film is deposited on a Si(100) substrate by synchrotron radiation irradiation. Reflection high-energy electron diffraction and high-resolution transmittance electron microscopy observation reveal that epitaxial growth can be realized at temperatures as low as 100 C. At substrate temperatures above 300 C, the films show a clear 2 x 1 reconstructed surface, indicating a fairly good crystal quality. Below 500 C, the growth rate increases as the substrate temperature is lowered, meaning that the surface adsorption of source gas and/or photogenerated radicals plays an important role in the epitaxial growth reaction. Author

A92-46377**SURFACE RESISTANCE OF Bi₂Sr₂Ca₁Cu₂O_y STRIP LINES MADE FROM GREEN SHEET**

SHIGETOSHI OHSHIMA, KATSURO OKUYAMA (Yamagata University, Yonezawa, Japan), KUNIO SAWAYA, and KEISUKE NOGUCHI (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5A, May 1, 1992, p. L539-L542. refs Copyright

The surface resistance, R_s , of Bi₂Sr₂Ca₁Cu₂O_y (2212) strip lines prepared by the doctor blade method was measured by the strip-line resonance method. The highest $T_c R = 0$ of these strip lines measured by the conventional dc method was about 80 K. The R_s values were very sensitive to the surface and grain morphology of the films. It was verified through SEM observation and X-ray analysis that the R_s values of strip lines consisting of crystal grains whose c axes were oriented normal to substrate were smaller than those of strip lines with nonoriented grains. The values were about 6-22 m-ohm at 70 K in the frequency range of 0.6-2.5 GHz. Author

A92-46379**HIGH JC Y-BA-CU-O THIN FILM ON METAL SUBSTRATES PREPARED BY CHEMICAL VAPOR DEPOSITION**

SHIN-YA AOKI, TAICHI YAMAGUCHI, YASUHIRO IJIMA, AKIRA

KAGAWA, OSAMU KOHNO (Fujikura, Ltd., Tokyo, Japan), SHIGEO NAGAYA, and TOSHIO INOUE (Chubu Electric Power Co., Nagoya, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5A, May 1, 1992, p. L547-L549. refs Copyright

Two substrates are employed to prepare high-Jc superconducting YBCO thin films at 700 C by CVD under low oxygen partial pressure. X-ray diffraction analysis is used to compare the samples made on a polycrystalline Ni-based alloy with YSZ and Ag buffers with those made on the same alloy but with a biaxially aligned YSZ 100 plane buffer. The former samples have a critical temperature of 84.5 K and a critical current density of 5700 A/sq cm, while the samples with the buffer offers higher values in each category. C.C.S.

A92-46382**NOVEL PROCESS FOR VISIBLE LIGHT EMISSION FROM SI PREPARED BY ION IRRADIATION**

YUKINORI OCHIAI, NORIO OOKUBO, HEIJI WATANABE, SHINJI MATSUI, YASUNORI MOCHIZUKI, HARUHIKO ONO, SHIGERU KIMURA, and TOSHINARI ICHIHASHI (NEC Corp., Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5A, May 1, 1992, p. L560-L563. refs Copyright

A novel process for visible light emission from Si has been successfully developed. The sample was irradiated with argon or chlorine ions in an ECR (electron cyclotron resonance) etching apparatus. After etching, the sample was placed in HF solution for 30 minutes. Visible light emission from the sample has been confirmed at a peak wavelength of 700 nm. Various characterizations have been performed, such as SEM and TEM observations, X-ray diffraction and FTIR spectroscopy. Anodized porous silicon is also characterized for comparison. Author

A92-47245**INTERSUBBAND ABSORPTION IN NARROW Si/SiGe MULTIPLE QUANTUM WELLS WITHOUT INTERFACIAL SMEARING**

K. FUJITA, S. FUKATSU, Y. SHIRAKI, H. YAGUCHI, and R. ITO (Tokyo, University, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 2, July 13, 1992, p. 210-212. Research supported by MOESC. refs Copyright

Si/Si(1-x)Ge(x) multiple quantum wells with abrupt heterointerfaces have been formed by segregant-assisted growth (SAG) with Sb. Distinct well-width dependence of intersubband absorption in the narrow quantum wells has been observed. The well-width dependence of the absorption peak energy is in good agreement with a calculation based on the Kronig-Penney model where interfacial smearing is taken to be less than 0.4 nm, suggesting the integrity of Si/Si(1-x)Ge(x) interfaces grown by SAG. Author

A92-47620**DIRECT OBSERVATION OF CRYSTAL GROWTH AND PREPARATION OF 2212-PHASE SINGLE CRYSTALS IN LI-DOPED Bi-Sr-Ca-Cu-O SYSTEM**

H. HOSHIZAKI, S. KAWABATA, N. KAWAHARA, H. ENAMI, T. SHINOHARA (Nippondenso Co., Ltd., Research Laboratories, Aichi, Japan), and T. IMURA (Aichi Institute of Technology, Toyota, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 121, no. 1-2, June 1992, p. 53-61. refs Copyright

A92-48258**ELECTRON CORRELATION IN THE HUBBARD MODEL IN D = + INFINITY DIMENSION - HEAVY ELECTRONS IN THE MOTT-TRANSITION REGION**

FUSAYOSHI J. OHKAWA (Hokkaido University, Sapporo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1615-1632. refs Copyright

The Hubbard model is studied for the Mott-transition region in

the limit of high dimension d approaches $+\infty$. Leading-order effects with respect to $1/d$ are local spin fluctuations, all of which are fully included in the single-site approximation (SSA). Because the SSA is reduced to solving the Anderson model, it is argued that a normal heavy-electron liquid forms through the Kondo effect. The Fermi-liquid relations are proven within the SSA. The other leading-order effects are mean fields of magnetism caused by exchange interaction. Therefore it depends on the competition between the Kondo effect and the exchange interaction which the ground state is, magnetic or paramagnetic. However, any other effect is a higher-order effect. The $1/d$ expansion from the heavy-electron liquid in the SSA is one of the most useful methods in examining lower-temperature phases in the real dimension.

Author

A92-48259

VARIATIONAL MONTE CARLO STUDIES OF THE HUBBARD MODEL IN ONE- AND TWO-DIMENSIONS - OFF-DIAGONAL INTERSITE CORRELATION EFFECTS

HIROMI OTSUKA (Osaka University, Toyonaka, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1645-1656. Research supported by MOESC. refs
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The ground state properties of the 1D and the 2D Hubbard models are investigated using a new variational Monte Carlo method. By generalizing the Gutzwiller variational wave function (GF) to take into account an off-diagonal intersite correlation, the metal-insulator transition mechanism at the half filling is examined. As Kaplan et al. first pointed out, the binding mechanism between doubly occupied sites and empty sites plays a crucial role for this transition; this is confirmed by examining the real space correlation function between these two kinds of sites. Results for the spin and the charge structure factors are presented as well as the momentum distribution function and are discussed in connection with the pairing effect. It is also found that in less-than half filling, the improvements of the structure factors at 2K (F) are realized as compared with GF results.

Author

A92-48260

ENERGY SPECTRUM OF ELECTRONS ON THREE DIMENSIONAL LATTICE IN EXTERNAL MAGNETIC FIELD

YASUMASA HASEGAWA (Himeji Institute of Technology, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1657-1662. refs
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Energy spectrum of electrons on 3D lattice (2D lattices coupled with interlayer hoppings) in the magnetic field along the (1, 1, 1) directions is investigated. The 2D Hofstadter's gaps become small as the electron hoppings between layers are increased. It is found that the critical value of the interlayer hoppings at which the largest gap is zero is close to the value of hoppings in the layer except for the small q , where q is the denominator of the flux through each unit square, $\phi = p/q$. This means that a finite gap is opened by a small anisotropy in the simple cubic lattice. The effects of the next-nearest-neighbor and third-nearest-neighbor hoppings are also investigated.

Author

A92-48262

UNCONVENTIONAL SUPERCONDUCTIVITY IN A THIN FILM

NOBUYUKI OGAWA, MANFRED SIGRSIT, and KAZUO UEDA (Tsukuba, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 5, May 1992, p. 1730-1741. Research supported by Japan Society for the Promotion of Science, SNSF, and MOESC. refs
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The multiple phase transition behavior of unconventional superconductivity confined in a thin film is investigated considering the example of a two component superconducting order parameter. First the series of possible superconducting phase transitions are discussed on the basis of a group theoretical analysis. Then the corresponding Ginzburg-Landau theory is used to derive the conditions for the occurrence of at least double transitions. Finally, the specific heat and the magnetic susceptibility are analyzed as

possible quantities to detect multiple phase transitions. The latter also provides a method to distinguish between time-reversal conserving and time-reversal breaking phase transitions. Author

A92-48289

EFFECT OF AG ADDITION ON THE CRYSTAL GROWTH IN BI CUPRATE SUPERCONDUCTORS

YASUNORI NAKAMURA (Toyohashi University of Technology, Japan), TAKEHIKO TSUKAMOTO (Toyota College of Technology, Japan), KUNIYUKI KOYAMA, and SEIICHIRO NOGUCHI (Toyohashi University of Technology, Japan) JIM, Materials Transactions (ISSN 0916-1821), vol. 33, no. 5, May 1992, p. 525-528. refs
Copyright

The effect of Ag addition on the crystal growth has been investigated in Bi cuprate superconductors. Bi(Pb)-Sr-Ca-Cu-Ag-O superconducting thin films were prepared by the RF sputtering method. The XRD pattern shows that these films are amorphous before annealing. Dispersed isolated atoms of Ag grow up to a pure metallic sphere of Ag during annealing. Neither silver alloy nor silver compound is formed. This was confirmed by EPMA and XRD. The lattice parameter c of the matrix does not change with increasing Ag content. Therefore, AG is not considered to be involved as a constituent element of the superconducting phase. SEM photographs and XRD patterns show that the (2212) phase in the Ag-added film crystallizes faster than the one in the Ag-free film. This effect is explained by squeezing Ag atoms from the matrix to release the stress.

Author

A92-48339

CARRIER CONCENTRATION DEPENDENCE ON TC IN $\text{Bi}_2\text{Sr}_{2-x}\text{RE}_x\text{CaCu}_2\text{O}_{8+\delta}$ (RE = ND AND CE)

KUNIYUKI KOYAMA, NORIKAZU TAHATA, and SEIICHIRO NOGUCHI (Toyohashi University of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1313-1317. refs
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Structure, resistivity and susceptibility have been measured in the $\text{Bi}_2\text{Sr}_{2-x}\text{RE}_x\text{CaCu}_2\text{O}_{8+\delta}$ (RE = Nd and Ce) system. The samples with $x = 0-1$ (RE = Nd) and $x = 0-0.25$ (RE = Ce) have almost single phases of the $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ structure. The x -dependence on T_c in the Ce-substituted system is almost twice as strong as that in the Nd-substituted one. The valences of Nd and Ce ions in the samples were determined from susceptibility measurement as trivalent and tetravalent, respectively. The hole concentration was determined from the Hall effect measurement. The results confirm that the hole concentration in the Ce-substituted system becomes twice as strong as that in the Nd-substituted one, as expected from the universal relationship between the T_c and the hole concentration in the $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ system.

Author

A92-48341

IN SITU X-RAY CHEMICAL ANALYSIS OF $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-x}$ FILMS BY

REFLECTION-HIGH-ENERGY-ELECTRON-DIFFRACTION TOTAL-REFLECTION-ANGLE X-RAY SPECTROSCOPY

MASAYUKI KAMEI, YUJI AOKI, TOSHIO USUI, and TADATAKA MORISHITA (ISTEC, Superconductivity Research Laboratory, Tokyo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1326-1328. Research supported by New Energy and Industrial Development Organization. refs
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Both the surface crystalline structure and chemical composition of Y-Ba-Cu-O film were examined in situ using reflection-high-energy-electron-diffraction and total-reflection-angle X-ray spectroscopy (RHEED-TRAXS). The chemical composition determined by TRAXS agreed well with that determined by inductively coupled plasma spectroscopy. The compositional deviation from $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{7-x}$ affected the surface crystalline structure of films, as was detected by RHEED and confirmed by

scanning electron microscopy. RHEED-TRAXS is a powerful tool for in situ examination of the crystal growth of Y-Ba-Cu-O films.

Author

A92-48342

CRITICAL CURRENT DISTRIBUTION IN COMPOSITE (NBTI)3SN WIRES

MASAICHI UMEDA (Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1329-1333. refs
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Critical current distributions in superconducting composite wires of Nb₃Sn alloyed with Ti were studied using the second-derivative analysis of the flux flow voltage state. Specimens were prepared for a reaction time of one to eight days at a heat treatment temperature of 675 C and measurements were carried out with short samples. It has been shown that the critical current distributions were mainly determined by variations in the area and the thermodynamic critical fields of the Nb₃Sn filaments. Author

A92-48347

LOW-TEMPERATURE SYNTHESIS OF DIAMOND FILMS IN THERMOASSISTED RF PLASMA CHEMICAL VAPOR DEPOSITION

ICHIRO WATANABE, TAKASHI MATSUSHITA, and KOUJYU SASAHARA (Kanazawa University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1428-1431. refs
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The synthesis of diamond films using radio-frequency (13.56 MHz) glow discharge plasma chemical vapor deposition (CVD) is investigated. A variety of films are prepared from a mixture of ethyl alcohol and hydrogen, and they are evaluated using Raman spectroscopy. Diamond films grow when external heating is used in combination with the radiofrequency glow discharge. The films grow at temperatures between 350 and 800 C. In this temperature range, film of reasonable quality is obtained at 550-600 C. The diamond grows even at the low temperature of 350 C although it contains a few nondiamond carbons. These temperatures are considerably lower than those generally regarded as the optimal regime for diamond growth. Author

A92-48349

BIAS EFFECT ON THE MICROSTRUCTURE AND DIFFUSION BARRIER CAPABILITY OF SPUTTERED TIN AND TiO(x)N(y) FILMS

PING JIN and SHIGEO MARUNO (Nagoya Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 5A, May 1992, p. 1446-1452. refs
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The microstructure of TiN and TiO(x)N(y) films deposited on Si(100) substrates in an Ar-N₂ or an Ar-N₂-O₂ gas mixture was evaluated with a high-resolution field emission SEM. The TiN films deposited under an applied negative substrate bias have an extremely dense microstructure with hillocks on the film surface caused by the high compressive stress. The addition of oxygen modifies the microstructure of TiN film, i.e., the hillocks disappeared on the surface of TiO(x)N(y) by virtue of the stress relaxation effect. It has been found through the experiment of internal thermal diffusion by annealing Al/TiN (or TiO(x)N(y))/Si in a vacuum that the diffusion barrier performance of the films is associated with the microstructure and internal stress in addition to the oxygen content itself. Author

A92-48649

ELLIPSOMETRIC EXAMINATION OF GROWTH AND DISSOLUTION RATES OF Ta₂O₅ FILMS FORMED BY METALORGANIC CHEMICAL VAPOR DEPOSITION

CHOON H. AN and KATSUHISA SUGIMOTO (Tohoku University, Sendai, Japan) Electrochemical Society, Journal (ISSN 0013-4651), vol. 139, no. 7, July 1992, p. 1956-1962. refs
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The formation process of Ta₂O₅ films in MOCVD using pentamethoxy tantalum (PMT) as a metal organic source and O₂ as reactant gas has been analyzed by in situ ellipsometry at deposition temperatures of 473-773 K. According to the change in the growth rate of the films, the formation process can be divided into three stages, the initial, the transition, and the final stages. The growth rate and the optical constant of the films were found to depend on the deposition temperature and the deposition time. All the films obtained at temperatures of 473-773 K had amorphous structures. The corrosion resistance of the films against a buffered HF solution depended on the deposition temperature. By annealing at 923 K in the air for 3.6 ks, amorphous Ta₂O₅ films deposited at temperatures higher than 673 K were transformed into polycrystalline structures. Ta₂O₅ films crystallized by annealing showed extremely high corrosion resistances. Author

A92-49480

CALCULATION OF STRESSES IN GAAS/SI STRAINED HETEROSTRUCTURES

KAZUO NAKAJIMA (Fujitsu Laboratories, Ltd., Atsugi, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 121, no. 3, July 1992, p. 278-296. refs
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The present theoretical model for determining the stress distribution in multilayer heterostructures accurately considers the difference between such crystalline parameters as the lattice constant and thermal expansion coefficient of crystalline layers. Each of the layers is viewed as divided into many imaginary thin layers, and the face force, moment, and strain balance are considered over all the imaginary thin layers with coherent interfaces. Stresses are on this basis calculated for 25 and 370 C in GaAs/Si and GaAs/graded GaAs-Si/Si heterostructures with coherent interfaces. O.C.

A92-49483

NUCLEATION AND GROWTH OF DIAMOND IN A MICROWAVE PLASMA ON SUBSTRATE PRETREATED WITH NON-OXIDE CERAMIC PARTICLES

HIDEAKI MAEDA, SUMIHISA MASUDA, KATSUKI KUSAKABE, and SHIGEHARU MOROOKA (Kyushu University, Fukuoka, Japan) Journal of Crystal Growth (ISSN 0022-0248), vol. 121, no. 3, July 1992, p. 507-515. Research supported by Society of Chemical Engineers of Japan. refs
Copyright

High resolution SEM is used to characterize changes in the morphology and nucleation density of an early stage of microwave plasma-enhanced CVD diamond formation on a p-type (100) silicon substrate surface which had been abraded with various ceramic particles suspended in acetone by an ultrasonic method. The abrasion implants fine abrasive particles on the substrate surface; these implanted particles act as nucleation sites for diamond from the vapor phase. Boride particles are noted to be especially effective, suggesting the function of B compounds in the CVD reaction. O.C.

A92-50415

CHARACTERIZATION OF PROCESSING-INDUCED DEFECTS IN HIGH-PURITY INP BY PHOTOLUMINESCENCE

K. M. MAYER, Y. MAKITA, A. YAMADA, H. SHIBATA, A. C. BEYE, and J. SHIMADA (Electrotechnical Laboratory, Tsukuba, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 3, Aug. 1, 1992, p. 1080-1085. Research supported by Science and Technology Agency of Japan and Alexander von Humboldt-Stiftung. refs
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Low-temperature photoluminescence experiments were performed on high-purity InP substrates as a function of heat treatment, flat-profile ion implantation, and subsequent annealing procedures. Whereas the well-resolved near-band-edge luminescence proved the superior substrate quality, up to six sharp luminescence lines (some of them not reported so far) and one shallow broad-band emission were observed after Si₃N₄ deposition

and various annealing procedures. From the temperature dependence of the luminescence peak, intensities the activation energies of the novel lines were determined and discussed in terms of excitons bound to processing-induced complex defects. These assignments are supported by the observation of a strong enhancement of the luminescence after low-dose Ar(+) ion implantation. Author

A92-50690* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CHARACTERISTICS OF A PROMISING NEW

THERMOELECTRIC MATERIAL - RUTHENIUM SILICIDE

TOSHITAKA OHTA (Electrotechnical Laboratory, Tsukuba, Japan), CRONIN B. VINING, and CAMILLO E. ALLEVATO (JPL, Pasadena, CA) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 3. La Grange Park, IL, American Nuclear Society, 1991, p. 196-201. refs

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A preliminary study on arc-melted samples has indicated that ruthenium silicide has the potential to obtain figure-of-merit values four times higher than that of conventional silicon-germanium material. In order to realize the high figure-of-merit values, high-quality crystal from the melt is needed. A Bridgman-like method has been employed and has realized much better crystals than arc-melted ones. I.E.

A92-50693

EVALUATION OF THERMOELECTRIC PERFORMANCE OF IRON DISILICIDES DOPED WITH OXYGEN

M. HAYASHIBARA, A. KOYANAGI, and M. TSUKAMOTO (Hitachi, Ltd., Energy Research Laboratory, Japan) IN: IECEC '91; Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, Aug. 4-9, 1991. Vol. 3. La Grange Park, IL, American Nuclear Society, 1991, p. 212-217. refs

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In order to improve the thermoelectric property of iron disilicides, the effect of oxygen concentration has been investigated. Specimens were prepared by vacuum evaporation of iron, oxidized silicon, and silicon on quartz plates. The thickness of the iron disilicide layer, doped with oxygen, was about 1 micron. The thermoelectric power, electric conductivity, and thermal conductivity were measured. From these values, the figure of merit of the specimen containing 36 at. percent oxygen was evaluated as about $2 \times 10^{-3}(\text{K}^{-1})$ at 620 K. Iron disilicides containing 28-36 at. percent oxygen deteriorated during heating in the atmosphere. The composition and bonding of an as-deposited specimen and a deteriorated specimen were measured in order to clarify deterioration behavior. The deterioration was caused by oxidation of Si and SiO, and a passivity layer which covers the iron disilicide is suitable for preventing it. I.E.

A92-51444

EFFECT OF UV LIGHT IRRADIATION ON THE A-AXIS ORIENTATION MECHANISM FOR Y1BA2CU3O(7-DELTA) FILMS PREPARED BY LASER METALORGANIC CHEMICAL VAPOR DEPOSITION

TAKAHISA USHIDA, HIROYUKI HIGA, KAZUTOSHI HIGASHIYAMA, IZUMI HIRABAYASHI, and SHOJI TANAKA (International Superconductivity Technology Center, Nagoya, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5B, May 15, 1992, p. L608-L611. refs

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A92-51447

PICOSECOND LUMINESCENCE DECAY IN POROUS SILICON

TAKAHIRO MATSUMOTO, MASAHIRO DAIMON, TOSHIRO FUTAGI, and HIDENORI MIMURA (Nippon Steel Corp., Electronics Research Laboratories, Sagami, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5B, May 15, 1992, p. L619-L621. refs

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Picosecond luminescence decay is observed for the first time in porous Si. This decay consists of two exponential decay components that become large with decreasing emission energy. Besides the picosecond luminescence decay, nanosecond luminescence decay was also observed. This shows nonexponential decay behavior with dominant components between 100 ns and 1 microsec. This also becomes large with decreasing emission energy. Based on the results, the luminescence in porous Si seems to originate partially from the amorphous phase. Author

A92-51448

IMPROVED SURFACE CRYSTALLINITY OF MGO CRYSTAL SUBSTRATE THROUGH ANNEALING IN OXYGEN ATMOSPHERE

TAKAHIRO AWAJI, KEN SAKUTA, YOSHIYUKI SAKAGUCHI, and TAKESHI KOBAYASHI (Osaka University, Toyonaka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 5B, May 15, 1992, p. L642-L645. Research supported by MOESC. refs

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An investigation is conducted of the oxygen annealing (OA) effects on commercially available MgO substrates. The smeared low-energy electron diffraction spot pattern and transmissionlike spot pattern of reflection high-energy electron diffraction were dramatically altered to those of almost ideal MgO crystals by OA at 1000 C. The 5 nm-thick epitaxial YBaCuO films grown on (100) MgO substrates with OA showed good superconductivity. R.E.P.

A92-51827

SINGLE-ELECTRON TUNNELING IN COUPLED QUANTUM DOTS

SHINGO KATSUMOTO (Tokyo, University, Japan), NAOKATSU SANO (Kwansei-Gakuin University, Nishinomiya, Japan), and SHIUN-ICHI KOBAYASHI (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L759-L761. refs

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An experiment was carried out on single-electron tunneling (SET) in two series-coupled 'quantum dots' (QDs, defined as a finite space where electrons are confined (Likharev, 1988)), prepared by split gates on two-dimensional electron gas at a GaAs/AlGaAs heterointerface. It was found that, in two QDs connected by quantum point contacts in series, Coulomb oscillations against gate voltages due to SET could be observed. This indicates that the energy levels in two QDs can be coherent for a substantial range of gate voltage. I.S.

A92-51828

ANISOTROPIC OPTICAL TRANSITIONS IN SEMICONDUCTOR QUANTUM WELLS

SHUNJI NOJIMA (NTT, Opto-Electronics Laboratories, Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L765-L767. refs

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Taking into account the multiplicity of the valence band, calculations are performed of the in-plane anisotropy of optical-transition matrix elements at the band edge for quantum well films (QWFs) of several crystallographic orientations, using the Hamiltonian matrix developed by Kane (1956) to describe the valence band in the vicinity of its zone center. Results showed that the (001) and the (111) films have an in-plane isotropy, while the (311) films revealed slight anisotropy and the (110) film showed marked anisotropy. The (111) film exhibited isotropic behavior despite the fact that each state of the doubly degenerate subband in the valence band produces an extremely anisotropic optical transition. I.S.

A92-51830

HIGH-RESOLUTION ELECTRON MICROSCOPY OBSERVATION OF DEFECTS IN 180 MEV CU(11+) ION-IRRADIATED BI2SR2CACU2O8 CRYSTALS

BERNARD CHENEVIER, SHOZO IKEDA, HIROAKI KUMAKURA,

KAZUMASA TOGANO (National Research Institute for Metals, Tsukuba, Japan), SATORU OKAYASU, and YUKIO KAZUMATA (Japan Atomic Energy Research Institute, Ibaraki) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L777-L779. Research supported by Science and Technology Agency of Japan. refs
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Irradiation with 180 MeV Cu(11+) ions, perpendicular to the surface of a 15-micron-thick Bi₂Sr₂CaCu₂O₈ layer, enhances the irreversibility fields and increases the values of the intragrain J_c of the superconducting material. Irradiation-induced structural damages have been observed by high-resolution electron microscopy. Crystal defects consist of long continuous cylindrical columns of highly damaged material that transverse the layer. Columns are parallel to the direction of the ion beam. Diameter values lie between 2 and 8 nm. Author

A92-51831

RELATIONSHIP BETWEEN SURFACE ROUGHNESS AND BARRIER UNIFORMITY

TOSHIYUKI MATSUI, TAKESHI SUZUKI, HIROSHI KIMURA, KOICHI TSUDA, MEGUMI NAGANO, and KAZUO MUKAE (Fuji Electric Corporate Research and Development, Ltd., Yokosuka, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L780-L783. refs
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The relationship between the surface roughness of YBa₂Cu₃O(x) (YBCO) films and the uniformity of a barrier layer was studied using atomic force microscope (AFM) and tunnel junctions with an Au-LaSrGaO₄(LSGO)-YBCO layered structure. AMF images showed that the surface roughness of both (001)- and (013)-oriented films depended strongly on their thickness, and that roughness decreased with a reduction of thickness. When an LSGO barrier was formed on these YBCO films, barrier height increased from 24 mV to 1.3 V with reduction in the thickness of the YBCO film from 400 nm to 70 nm. This suggests that barrier uniformity was improved by reducing the roughness of the YBCO films. Author

A92-51832

PREPARATION OF YBa₂Cu₃O(7-DELTA) SUPERCONDUCTOR COATING ON AUSTENITIC STEEL BY ELECTROPHORETIC DEPOSITION METHOD - STUDY ON BUFFERING LAYERS
NAOTAKA MINAMI, NOBUYUKI KOURA, and HIROMASA SHOJI (Tokyo University of Science, Noda, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L784-L786. Research supported by MOESC. refs
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A preparation method of a superconducting oxide, YBa₂Cu₃O(7-delta) coating on austenitic stainless steel by electrophoretic deposition at high voltages has been investigated in order to increase the J_c value. Without a buffering layer, Ni, Cr, and Fe atoms diffused from the substrate to the superconductor phase. It was found that ZrO₂ and Ag layers coated on the substrate as the buffering layer restrain the diffusion of the metals. Consequently, high density YBa₂Cu₃O(7-delta) superconductor coating could be obtained at high voltage depositions, therefore, it indicated that high-J_c samples can be prepared by this method. Author

A92-51833

PREPARATION OF YBa₂Cu₃O(X) THIN FILMS BY LAYER-BY-LAYER METALORGANIC CHEMICAL VAPOR DEPOSITION

KOUJI FUJII, HIDEAKI ZAMA, and SHUNRI ODA (Tokyo Institute of Technology, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L787-L789. Research supported by MOESC and TEPCO Research Foundation. refs
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The preparation of YBa₂Cu₃O(x) thin films on MgO(100) substrates by sequential metalorganic source supply with the metal configuration along the c-axis at low substrate temperature (560

C) was investigated. Oxygen is also sequentially supplied to the substrate. Four types of film are prepared by various sequential supply patterns of metalorganic precursors and oxygen. The results show that layer-by-layer oxidation is important for c-axis orientation of the films and that Ba is more suitable than Cu as the first layer with respect to preventing the growth of CuYO₂. Author

A92-51834

MORPHOLOGY OF C60 SINGLE CRYSTALS

YOSITAKA YOSIDA (Iwaki-Meisei University, Iwaki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6B, June 15, 1992, p. L807-L809. refs
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Scanning electron microscope (SEM) observations have been made for pure C₆₀ (99.8 percent) single crystals. Morphological features obtained from SEM images were compared to those of a truncated octahedron, which is one of the habits of face-centered cubic crystals. Experimental results of interfacial angles between facets showed excellent agreement with those expected from the model. Author

A92-51835

ESTIMATION OF CRITICAL THICKNESSES AND BAND LINEUPS IN ZNCDSE/ZNSSE STRAINED-LAYER SYSTEM FOR DESIGN OF CARRIER CONFINEMENT QUANTUM WELL STRUCTURES

YI-HONG WU, KUNIO ICHINO, YOICHI KAWAKAMI, SHIZUO FUJITA, and SHIGEO FUJITA (Kyoto University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1737-1744. Research supported by Mazda Foundation. refs
(Contract MOESC-03204014)
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For the fabrication of practical single and multiple semiconductor quantum wells (QWs) capable of confining carriers in the well layers, it is essential that the compositions and thicknesses of constituent layers be suitably chosen to yield sufficiently large conduction and valence band offsets between well and barrier layers, and to avoid lattice relaxation. In this paper a guideline is presented for the design of strained-layer ZnCdSe/ZnSse carrier confinement QWs which satisfy such requirements, based on the estimations of critical thicknesses and band lineups of the structures. From the results obtained here, ZnCdSe/ZnSse QWs are demonstrated to be eminently suitable for applications to optoelectronic devices operating in the blue-green region of the spectrum. Author

A92-51837

FABRICATION AND PROPERTIES OF MgO/Bi₂Sr₂CaCu₂O(X) INTERFACES USING CRYSTALLINE AND AMORPHOUS MgO FILMS GROWN BY THE MBE METHOD

KOJI YAMANO, KAZUHIRO SHIMAKA, KAZUHIKO TAKAHASHI, TATSURO USUKI, YORINOBU YOSHISATO, and SHOICHI NAKANO (Sanyo Electric Co., Ltd., Functional Materials Research Center, Hirakata, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1765-1770. Research supported by New Energy and Industrial Technology Development Organization. refs
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Tunnel-type junctions with pinhole-free crystalline and amorphous MgO barriers on the order of several nm were successfully fabricated on the cleavage plane of BSCCO single crystals. Both MgO films for the tunnel barriers were grown by the MBE method. The superconducting gap parameters of a BSCCO single crystal deposited with crystalline and amorphous tunnel barriers were estimated to be 25 meV and 38 meV, respectively, for the configuration of a Nb/MgO/BSCCO junction from dI/dV-V characteristics. The possibility of different surfaces superconductivities for BSCCO single crystals was determined by the characterization of the MgO/BSCCO interface. Author

A92-51840

CHANGES OF SUPERCONDUCTIVITY AND CRYSTAL STRUCTURE ON $\text{Ba}_2\text{YCu}_3\text{O}_{7-x}$ THIN FILM BY 2.5 MEV Ni^{2+} ION IRRADIATION

TAKAYUKI TERAI, KAZUYUKI KUSAGAYA, TAI FURUTA, YOICHI TAKAHASHI (Tokyo, University, Japan), SHUGO KUBO, and YUICHI ENOMOTO (NTT, Applied Electronics Laboratory, Tokai, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6A, June 1992, p. 1784, 1785. refs
Copyright

Effects of 2.5 MeV Ni^{2+} ion irradiation on thin films of high-Tc oxide superconductor $\text{Ba}_2\text{YCu}_3\text{O}_{7-x}$ were investigated in the fluence range of 1.0×10^{19} to 3×10^{19} exp 9/sq cm to 14/sq cm. An increase of transport J_c due to irradiation was observed below 1.0×10^{19} exp 10/sq cm in fluence, while above fluence, both T_c and J_c decreased. In X-ray diffraction measurement, decrease in intensity and increase in the FWHM value of peaks and the c-axis lattice constant were observed above 1.0×10^{19} exp 13/sq cm in fluence.
Author

A92-52208

PHOSPHORUS AND NITROGEN DOPING INTO POLYCRYSTALLINE SIC FILMS PREPARED BY PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITION AT 700 C

S. HASEGAWA, N. FURUTA, T. TAKESHITA, T. INOKUMA, and Y. KURATA (Kanazawa University, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 4, Aug. 15, 1992, p. 1374-1377. Research supported by Hoso-bunka Foundation. refs

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A92-53184

TEXTURED $\text{ZnO}:\text{Al}$ FILMS FOR SOLAR CELLS BY DC-MAGNETRON SPUTTERING IN WATER VAPOR PLASMA
TOKIO NAKADA, YUKINOBU OHKUBO, and AKIO KUNIOKA (Aoyama Gakuin University, Tokyo, Japan) IN: IEEE Photovoltaic Specialists Conference, 22nd, Las Vegas, NV, Oct. 7-11, 1991, Conference Record. Vol. 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 1389-1392. refs
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The successful production of low-resistive textured $\text{ZnO}:\text{Al}$ films for solar cells by dc-magnetron sputtering is discussed. The surface morphology and grain structure were strongly affected by the addition of water vapor during sputtering. Low-resistive pyramidal textured $\text{ZnO}:\text{Al}$ films were deposited onto glass substrates in the presence of water vapor at 300-400 C. The 2-micron-thick films possessed a sheet resistance of 9 Ohm/area and optical transmission 80 percent at 550 nm after annealing in a vacuum. The textured/flat-surface $\text{ZnO}:\text{Al}$ bilayers with sheet resistance of 4 Ohm/area were also obtained.
I.E.

A92-53426

EFFECT OF SUBSTRATE BIAS ON SILICON THIN-FILM GROWTH IN PLASMA-ENHANCED CHEMICAL VAPOR DEPOSITION AT CRYOGENIC TEMPERATURES

HIDETOSHI SHIN, KATSUHIKO OKAMOTO, SEIICHI MIYAZAKI, and MASATAKA HIROSE (Hiroshima University, Higashi-Hiroshima, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6B, June 1992, p. 1953-1957. refs
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A92-53427

SYNTHESIS OF DIAMOND USING FE CATALYSTS BY RF PLASMA CHEMICAL VAPOR DEPOSITION METHOD

YOSHIHITO SHIMADA, NOBUKI MUTSUKURA, and YOSHIO MACHI (Tokyo Denki University, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 6B, June 1992, p. 1958-1963. refs

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Diamond growth was examined on a Fe/Si substrate in RF CH_4 plasma. The Fe film, evaporated on a Si wafer, promotes the growth of diamond. Although the density of the diamond particle

grown on a Si substrate was on the order of 10^{16} exp 6/sq cm, the Fe film enhanced the density to an order of 10^{16} exp 7/sq cm. The particle size was increased with the increase in the Fe film thickness, and indicated a maximum value at around 500 A. At an initial stage in the diamond growth, it was confirmed that C and Fe atoms diffused deeply into the Fe film and the Si substrate, respectively, which was confirmed by X-ray photoelectron spectroscopy measurements. It was also observed that the diamond particles exist at the interface between the Fe film and Si substrate.
Author

A92-53752

CONTROL OF FLATNESS OF CRYSTAL-MELT INTERFACE BY CRYSTAL ROTATION IN CZOCHRALSKI GROWTH OF OXIDE SINGLE CRYSTALS

AKIRA HIRATA, SHIN-ICHI NISHIZAWA (Waseda University, Japan), and YASUNORI OKANO (Tohoku University, Sendai, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2125-2130. refs
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The control of crystal-melt interface shape by crystal rotation rate during Czochralski growth of oxide single crystals were theoretically studied. Effects of the melt properties and operational conditions on the critical crystal rotation rate at which the crystal-melt interface becomes flat were clarified. A method of evaluating the dominant convection in the melt using the operational factors was proposed. Applying this method to previous experimental results for the crystal-melt interface, it was suggested that in most of them Marangoni convection was more dominant than natural convection in the melt. It was shown that the results obtained in this study could adequately explain the previous experimental values of the critical crystal rotation rate.
Author

A92-53788

FAST RECOVERY FROM EXCITONIC ABSORPTION BLEACHING IN TYPE-II GaAs/AlGaAs/AlAs TUNNELING BIQUANTUM WELL

ATSUSHI TACKEUCHI, TSUGUO INATA, YOSHIHIRO SUGIYAMA, YOSHIKI NAKATA, SATOSHI NAKAMURA, and SHUNICHI MUTO (Fujitsu Laboratories, Ltd., Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6A, June 1, 1992, p. L669-L672. refs
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A type-II tunneling biquantum-well (TBQ) structure which consists of a series of GaAs wells, AlGaAs barriers and AlAs layers is proposed. The type-II TBQ has no significant optical absorption except for the GaAs wells and shows fast recovery from excitonic absorption bleaching. In this structure, photoexcited electrons in the GaAs wells escape by tunneling through the AlGaAs barriers toward X states in the AlAs layers. The recovery time of excitonic absorption bleaching in the GaAs wells was reduced to 8 ps as the AlGaAs barrier thickness was decreased to 1.1 nm.
Author

A92-53789

THICK $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_x$ FILMS WITHOUT SUBSTRATES PREPARED BY DIP-SUSPENSION IN MELTS

TAKASHI YOMO, YOSHIKI TANAKA, and RYOZI SUGANUMA (Ritsumeikan University, Kyoto, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6A, June 1, 1992, p. L673-L675. refs

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$\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_x$ films about 100-300 microns thick without substrates were prepared by dipping Pt loops in melts, with subsequent melt-suspension solidification. After annealing at 1113 K for 1 hr, the films are shown to contain the 2212 low-Tc phase. Based on the results of X-ray powder diffraction analysis, the structure of the films prepared by the dip-suspension method is compared to that of thick films produced on MgO substrates by the melt-crystallization method.
V.L.

A92-53793

PRESSURE-INDUCED PASCHEN-BACK EFFECT OF R-LINES IN ALEXANDRITE UNDER HIGH MAGNETIC FIELD

NORITAKA KURODA, HIROYUKI KANDA, GIYUU KIDO, MASAYASU TAKEDA, YUICHIRO NISHINA, and YASUAKI NAKAGAWA (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 6A, June 1, 1992, p. L700-L702. refs

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Magneto-luminescence of R-lines has been studied in alexandrite subjected to quasi-hydrostatic pressures near 8 GPa at 77 K. In contrast to the previous experiment under low pressures, the Zeeman spectrum exhibits Paschen-Back behavior if a magnetic field up to 15 T is applied parallel to the b- and c-axes of the crystal. This phenomenon reflects that the transverse moment of spins of the 2E term of Cr(3+) ions is significantly reduced by pressure. Pressure strengthens the Ising character of the spins by elevating axial symmetry of the crystal field. Author

A92-54431

A THEORETICAL INVESTIGATION OF THE METASTABILITY OF EPITAXIAL ALPHA-Sn ON A (100) ZINC BLENDE SUBSTRATE

TOMONORI ITO (NTT, LSI Laboratories, Atsugi, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L920-L923. refs

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The metastability of alpha-Sn with a diamond structure on a (100) zinc blende substrate is discussed based on cohesive energy calculations for bulk form and thin layers using the pseudopotential perturbation approach and universal empirical potentials. In the bulk form, alpha-Sn is found to be more stable than beta-Sn with double-bct structure by 50 meV/atom at 0 K. However, the beta-Sn is stabilized by the contribution of vibration entropy at high temperatures. The stabilization of alpha-Sn on the (100) zinc blende substrate is due to small coordination number change at the interface between thin films and substrate. On the zinc blende CdTe substrate, alpha-Sn is more stable than beta-Sn by 291 meV/atom at the interface region and 628 meV/atom at the thin films region. Author

A92-54432

OBSERVATION OF RESISTIVE AND MAGNETIC ANOMALIES AT 90-180 K IN ARTIFICIALLY LAYERED CA(1-X)SR(X)CUO2 THIN FILMS GROWN BY LASER MOLECULAR BEAM EPITAXY

XIAOMIN LI, TOMOJI KAWAI, and SHICHIO KAWAI (Osaka University, Ibaraki, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L934-L937. refs

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A92-54434

THE SUPERCONDUCTING PROPERTIES OF (001) TWIST BOUNDARIES IN A Bi-SR-CA-CU-O SUPERCONDUCTOR

NARUAKI TOMITA, YUTAKA TAKAHASHI, MINORU MORI, and YOICHI ISHIDA (Tokyo, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L942-L945. Research supported by MOESC. refs

Copyright

Critical temperature (T_c) and critical current density (J_c) of (001)-twist bicrystals of the $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(x)$ were measured as a function of twist angle. The resistivity-temperature curve of the bicrystal showed a long tail, which was enhanced as the applied current increased. The J_c values of the bicrystals are three to four orders of magnitude lower than that of single crystals but relatively high J_c values were obtained for bicrystals at Sigma5 and Sigma17 coincidence orientation relationships. It was indicated that the (001) twist boundary in $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}(x)$ was the weak link, and is suggested that there existed a less detrimental grain orientation. Author

A92-54435

MOLECULAR BEAM EPITAXY FABRICATION OF SrTiO_3 AND $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ HETEROSTRUCTURES USING A NOVEL REFLECTION HIGH-ENERGY ELECTRON DIFFRACTION MONITORING TECHNIQUE

PETER BODIN, SHIGEKI SAKAI, and YUJI KASAI (Electrotechnical Laboratory, Tsukuba, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L949-L952. refs

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SrTiO_3 and $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ layered structures were continuously grown by the molecular beam epitaxy technique with in situ reflection high-energy electron diffraction (RHEED). By using a new RHEED picture subtraction technique, intensity changes due to only the topmost layer could be displayed. This method allows us to sensitively detect roughness on the atomic scale and excess phase formation. The SrTiO_3 layer could be grown by sequential shuttering as well as coevaporation. A heterostructure with a 60 Å $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ film had a superconducting transition temperature of 53 K. Author

A92-54436

FABRICATION OF YBCO/CEO₂/YBCO MULTILAYER JUNCTIONS AND THEIR CHARACTERISTICS

TAKESHI KUSUMORI and IENARI IGUCHI (Tsukuba, University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L956-L959. Research supported by MOESC and Support Center for Advanced Telecommunications Technology Research. refs

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The fabrication of YBCO/ CeO_2 /YBCO multilayer junctions grown by the in situ vacuum deposition technique is reported. The measurements yield reproducible characteristics. The observed phenomena appear either in the tunneling regime or in the Andreev-reflection-like depending on the magnitude of the junction resistance. Prominent gaplike structures around 10 mV and 20 mV and additional structures are observed. Temperature dependence of the gap structures is nearly BCS-like. The results are discussed in terms of an anisotropic conduction model. Author

A92-54437

STABLE ONE-DIMENSIONAL QUASI CRYSTAL IN A AL-CU-FE-MN SYSTEM

AN P. TSAI (Tohoku University, Sendai, Japan), AKIRA SATO, AKIJI YAMAMOTO (National Institute for Research in Inorganic Materials, Tsukuba, Japan), AKIHISA INOUE, and TSUYOSHI MASUMOTO (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L970-L973. Research supported by MOESC. refs

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A stable one-dimensional quasi-crystal was formed in a fully annealed $\text{Al}_{65}\text{Cu}_{20}\text{Fe}_{10}\text{Mn}_5$. It was confirmed by stereographic electron diffraction analysis that the one-dimensional quasi-crystal has a modified decagonal structure with 6-layer periodicity along the original c axis and 8-layer periodicity in the P direction. Microscopic observation reveals a linking columnar morphology with planar facets around the columns. The columnar direction is identified to coincide with the pseudotenfold(c) axis. Author

A92-54438

SCANNING TUNNELING MICROSCOPY OF C₆₀ ON THE Si(111)7 X 7 SURFACE

XIANG-DONG WANG, TOMIHIRO HASHIZUME (Tohoku University, Sendai, Japan), HISANORI SHINOHARA, YAHACHI SAITO (Mie University, Tsu, Japan), YUICHIRO NISHINA, and TOSHIO SAKURAI (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7B, July 15, 1992, p. L983-L986. refs

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Adsorption of C_{60} molecules on the $\text{Si}(111)7 \times 7$ surface was investigated using a field ion-scanning tunneling microscope. C_{60}

adsorbs preferentially on the faulted half of the 7×7 unit and stays still without rotation at room temperature, implying the reasonably strong interaction with the Si substrate. The internal structure of individual C60 molecules can be understood if it is assumed that the C = C double bonds are imaged brightly. Unlike the case of its adsorption on the Si(100) 2×1 surface, C60 do not form ordered mono/multi layers on the 7×7 surface.

Author

A92-54440

OBSERVATION OF JOSEPHSON JUNCTIONLIKE BEHAVIOR IN SINGLE-CRYSTAL (Bi, Pb)2Sr2CaCu2O(y)

GIN-ICHIRO OYA, NAOTO AOYAMA, AKINOBU IRIE (Utsunomiya University, Japan), SATORU KISHIDA, and HEIZO TOKUTAKA (Tottori University, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L829-L831. Research supported by MOESC. refs

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The dependences of critical current on the temperature and magnetic field and the current-voltage characteristics in response to incident microwave radiation are measured in the direction of the c-axis of the 80 K superconducting phase (Bi, Pb)2Sr2CaCu2O(y) bulk single crystal. Josephson junctionlike behavior is successfully observed, and it shows that the single crystal itself is composed of Josephson junctions along the c-direction and that its electrical transport in this direction is limited by intrinsic tunnel barriers existing in the single crystal. Author

A92-54443

THE POSSIBILITY OF PROXIMITY EFFECT IN Pb/LaNiO3(THICKNESS: 59 NM)/Bi-Sr-Ca-Cu-O TRILAYER JUNCTION

AKIO ENOMURA (Nippon Sheet Glass Co., Ltd., Tsukuba Research Laboratory, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L877-L879. refs

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A Pb(superconductor)/LaNiO3(thickness: 59 nm)/Bi-Sr-Ca-Cu-O (high Tc superconductor) trilayer junction was prepared on a (100) MgO single crystal and the current(I)-voltage(V) characteristics were examined. Judging from the nonlinear I-V curve, it was tentatively concluded that LaNiO3 is one of the barrier materials which has a long range proximity effect. Author

A92-54444

FIELD ION-SCANNING TUNNELING MICROSCOPY STUDY OF C60 ON THE Si(100) SURFACE

TOMIHIRO HASHIZUME, XIANG-DONG WANG, YUICHIRO NISHINA, HISANORI SHINOHARA, YAHACHI SAITO, YOUNG KUK, and TOSHIO SAKURAI (Tohoku University, Sendai, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L880-L883. refs

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Field ion-scanning tunneling microscopy was employed to study the monolayer and multilayer adsorption behaviors of the C60 fullerene on the Si(100) 2×1 surface. The C60 molecules reside stably in the trough at room temperature without rotation, encompassing the 8 neighboring dimer-forming surface Si atoms with the nearest neighbor distance of 12 Å. For the first and second layers, only local ordering of square and quasi-hexagonal patterns was observed. The orderly Stranski-Krastanov mode island formation with the hexagonal packing was observed above the third layer with its lattice constant of 10.4 Å. Author

A92-54447

ELECTRICAL CONDUCTIVITY AND ESR SPECTRUM OF BUCKMINSTERFULLERENE-DOPED POLY(3-ALKYLTHIOPHENE)

SHIGENORI MORITA, ANVAR A. ZAKHIDOV, TSUYOSHI KAWAI, HISASHI ARAKI, and KATSUMI YOSHINO (Osaka University, Suita, Japan) Japanese Journal of Applied Physics, Part 2 (ISSN 0021-4922), vol. 31, no. 7A, July 1, 1992, p. L890-L893. refs

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Buckminsterfullerene (C60) is effectively doped in poly(3-alkylthiophene). However, the characteristics of C60-doped poly(3-alkylthiophene) are different from the typical behavior observed in the case of conventional dopants. Electrical conductivity of poly(3-alkylthiophene) increases upon C60 doping and decreases again at higher concentration of C60. Its temperature dependence is also anomalous. The absorption spectrum changes markedly upon C60 doping. ESR linewidth decreases from 7.1 G to 1.9 G upon C60 doping. Spin density, evaluated by ESR, is enhanced upon C60 doping. These doping characteristics are tentatively explained by taking electronic energy diagrams of both poly(3-alkylthiophene) and C60 into consideration. Author

A92-54459

CHARACTERIZATION OF DIAMOND FILMS BY MEANS OF A PULSED POSITRON BEAM

RYOICHI SUZUKI (Electrotechnical Laboratory, Tsukuba, Japan), YOSHINORI KOBAYASHI (National Chemical Laboratory for Industry, Tsukuba, Japan), TOMOHISA MIKADO, HIDEAKI OHGAKI, MITSUKUNI CHIWAKI, TETSUO YAMAZAKI (Electrotechnical Laboratory, Tsukuba, Japan), AKIRA UEDONO (Tokyo, University, Japan), SHOICHIRO TANIGAWA (Tsukuba, University, Japan), and HIROYUKI FUNAMOTO (Seiko Instruments, Inc., Matsudo, Japan) Japanese Journal of Applied Physics, Part 1 (ISSN 0021-4922), vol. 31, no. 7, July 1992, p. 2237-2240. Research sponsored by Science and Technology Agency of Japan. refs

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Positron lifetime spectra of thin diamond films synthesized by microwave plasma-enhanced chemical vapor deposition have been measured with a variable-energy pulsed positron beam in order to characterize defects in the diamond films. A positron lifetime experiment on bulk diamond synthesized at high pressures has also been carried out. It has been found that there exists a high concentration of vacancy-type defects in the films and the defect properties are strongly influenced by the deposition condition. Positronium formation in voids has been observed in all of the films but not in the bulk diamond. The void sizes have been estimated from the lifetime values of ortho-positronium components. The present study demonstrates that pulsed positrons can be used nondestructively and sensitively to characterize defects in thin diamond films. Author

A92-54679

SIZE EFFECTS APPEARING IN THE RAMAN SPECTRA OF POLYCRYSTALLINE DIAMONDS

YOSHIKATSU NAMBA, EBRAHIM HEIDARPOUR (Tokyo University of Agriculture and Technology, Koganei, Japan), and MASATOSHI NAKAYAMA (TDK Corp., Ichikawa, Japan) Journal of Applied Physics (ISSN 0021-8979), vol. 72, no. 5, Sept. 1, 1992, p. 1748-1751. refs

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Various spectra of Raman for different grain sizes of diamond powder have been studied. The spectra are also correlated to the results of transmission electron diffraction, transmission electron microscopy, scanning electron microscopy, and X-ray photoelectron spectroscopy. When the Raman peak intensity was decreased, the spectra broadened and shifted to a lower frequency in accordance with the decrease of the grain size. Finally, in the region of a few hundred angstroms, the detected signals were almost comparable to the noise level. While unchanged, lattice spacings for transmission electron diffraction patterns and constant peak heights for X-ray photoelectron spectroscopy analysis were observed for different grain sizes. Author

A92-54707

EFFECTS OF THERMAL ANNEALING ON POROUS SILICON PHOTOLUMINESCENCE DYNAMICS

NORIO OOKUBO, HARUHIKO ONO, YUKINORI OCHIAI, YASUNORI MOCHIZUKI, and SHINJI MATSUI (NEC Corp., Fundamental Research Laboratories, Tsukuba, Japan) Applied

76 SOLID-STATE PHYSICS

Physics Letters (ISSN 0003-6951), vol. 61, no. 8, Aug. 24, 1992, p. 940-942. refs
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Spontaneously oxidized porous silicon was subjected to thermal annealing and subsequently studied by photoluminescence spectra, decay dynamics, IR absorption spectra, and electron-spin-resonance (ESR) measurements. The PL decay was highly nonexponential and well described by the stretched-exponential function. The PL lifetime was shorter for the higher PL photon energy, but at the same photon energy it decreased by an order of magnitude by the thermal annealing in N₂ gas, in parallel with the large PL intensity decrease. It is suggested that this PL quenching upon the annealing is ascribable to both the structural changes and dangling bond formations in porous Si, as suggested by ESR measurements and the annealing experiments in H₂ gas. C.A.B.

A92-54713

GROWTH OF INAS ON EUBA₂CU₃O(7-Y)

SUPERCONDUCTING THIN FILMS WITH SRF₂ INTERLAYERS

Y. WATANABE, F. MAEDA, M. OSHIMA (NTT, Interdisciplinary Research Laboratories, Musashino, Japan), and O. MICHIKAMI (NTT, Interdisciplinary Research Laboratories, Tokai, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 8, Aug. 24, 1992, p. 979-981. refs
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In order to prevent reactions at the superconducting EuBa₂Cu₃O(7-y) (EBCO) and InAs interface, Srf₂ interlayers were grown on EBCO thin films. X-ray photoemission spectroscopy study demonstrates the effectiveness of Srf₂ interlayers in suppressing both removal of oxygen from the EBCO surface and oxidation of the InAs overgrown at room temperature. To crystallize InAs, a two-step growth process was applied. X-ray diffraction results show the 1-micron-thick InAs to be mainly 111 plane oriented crystalline. The T_c (zero)'s for InAs-deposited EBCO and annealed EBCO (300 C) are 73 and 82 K, respectively, implying that the use of an interlayer and two-step growth process is promising for depositing InAs layers without disruption of the underlying EBCO. Author

A92-55322

TRANSMISSION ELECTRON DIFFRACTION STUDY OF C70 PHASE TRANSFORMATION AT LOW TEMPERATURE

M. TOMITA (NTT, Interdisciplinary Research Laboratories, Musashino, Japan; Cambridge, University, United Kingdom), T. HAYASHI (NTT, Interdisciplinary Research Laboratories, Musashino, Japan), P. GASKELL (Cambridge, University, United Kingdom), T. MARUNO, and T. TANAKA (NTT, Interdisciplinary Research Laboratories, Musashino, Japan) Applied Physics Letters (ISSN 0003-6951), vol. 61, no. 10, Sept. 7, 1992, p. 1171-1173. refs
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C70 grown on a NaCl substrate is observed by transmission electron microscopy at low temperature (104 K). New spots that appear reproducibly in the electron diffraction (ED) at low temperature can be indexed as (m +/- 1/2, n +/- 1/2, 0) (m,n: integer) in a 001 (hcp) line type projection. The lattice constant a is lower at low temperature and the reduction ratio is a (104 K)/a(300 K) = 1.02/1.06 nm = 0.96 +/- 0.02, which is much lower than the value reported for C60. The ED of the low-temperature phase is observed below about 260 K, and an intermediate state is also detected in this temperature range. Author

A92-56188

INDIUM TIN OXIDE THIN FILMS PREPARED BY THERMAL DECOMPOSITION OF ETHYLENE GLYCOL SOLUTION

OSAMU YAMAMOTO, TADASHI SASAMOTO (Kanagawa Institute of Technology, Atsugi, Japan), and MICHIO IMAGAKI (Hokkaido University, Sapporo, Japan) Journal of Materials Research (ISSN 0884-2914), vol. 7, no. 9, Sept. 1992, p. 2488-2491. refs
(Contract MOESC-05750585)
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Indium tin oxide (ITO) films were prepared on a glass substrate

by thermal decomposition of ethylene glycol (EG) solutions which were prepared by dissolving indium and tin chlorides into ethylene glycol and then heating the solution at 200 C. Homogeneous ITO film with a thickness of 1 micron without any cracks was obtained from the EG solution with a viscosity of about 50 cSt by spin coating, with the rotation of the substrate at 2000 rpm. The crystallization of the film thus obtained occurred above 400 C. A well-crystallized ITO film was obtained by heat-treating at 600 C. The resistivity of the ITO film obtained on a glass substrate showed a minimum value of 0.00011 ohm cm at about 7 at. pct Sn.

Author

N92-15779# Argonne National Lab., IL

EVALUATION OF THE TOROIDAL-TYPE SUPERCONDUCTING MAGNETIC ENERGY STORAGE SYSTEM (SMES)

SEIICHIRO TERAI (Argonne National Lab., IL), TAKUYA KISHIDA (Argonne National Lab., IL), TAJI MINAGUCHI (Argonne National Lab., IL), YOSHISHIGE MURAKAMI (Argonne National Lab., IL), KATSUYOSHI TOYOTA (Argonne National Lab., IL), NAOHIRO DOKI (Argonne National Lab., IL), and MASAICHI FUKADA (Mitsubishi Electric Corp., Kobe, Japan) 22 Jun. 1990 6 p Presented at the 1990 National IEE Convention, Japan, 28-30 Mar. 1990

(Contract W-31-109-ENG-38)

(DE91-017797; ANL-TRANS-90-13; CONF-9003288-1) Avail: CASI HC A02/MF A01

This study reports evaluations of the basic system of a toroidal-type superconducting magnetic energy storage system which has several MJ of magnetically stored energy. DOE

N92-15812# Japan Atomic Energy Research Inst., Tokyo.

MECHANOCHEMICAL EFFECTS ON HIGH-T(SUB C) SUPERCONDUCTOR POWDERS

TAICHI YAMADA (Japan Atomic Energy Research Inst., Tokyo.), RYUJI NAGAI (Japan Atomic Energy Research Inst., Tokyo.), MANABU TAKEUCHI (Ibaraki Univ., Mito, Japan), and EISUKE MINEHARA Mar. 1991 31 p In JAPANESE; ENGLISH summary
(DE91-508077; JAERI-M-91-029) Avail: CASI HC A03/MF A01

We have investigated the mechanochemical effects on high-T_c superconductor YBa₂Cu₃O_{7-delta} powders. The powder was mechanically ground in air using an agate mortar with a pestle. The grinding time was varied from 2 to 100 min. The mean particle sizes of the powders were measured by a sedimentation method. The degradation of superconductivity was evaluated by the measurements of the crystallinity and volume fraction of the superconducting phase. The crystallinity was estimated from X-ray diffraction patterns. The volume fraction of the superconducting phase was estimated from the diamagnetization. The results of these changes of 2 min. and 100 min. grinding are respectively as follows: (1) mean particle size: 10.8 microns and 7.2 microns; (2) crystallinity: 40.0 percent and 24.8 percent; (3) volume fraction of superconducting phase: 91.5 percent and 30.0 percent. Recovery of the crystallinity and superconductivity of the ground specimens by re-sintering and re-annealing was also studied. It was found that the recovery of both of the characteristics was not complete. DOE

N92-21620*# International Superconductivity Technology Center, Tokyo (Japan). Superconductivity Research Lab.

STRUCTURE AND SUPERCONDUCTING PROPERTIES OF ((LN(1-X)LN*(X) 1/2 (BA(1-Y)SR(Y) 1/3 CE 1/6)8CU6O(Z) Abstract Only

H. YAMAUCHI, T. WADA, A. ICHINOSE, Y. TAEGASHI, T. KANEKO, S. IKEGAWA, and S. TANAKA In NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 115 Jan. 1991

Avail: CASI HC A01/MF A04

A variety of new oxide superconductors were prepared. The crystallographic structures of the oxides were all tetragonal and of the (Ln(+),Ce)4(Ln(+),Ba)4Cu6O_z (Ln(+) = Nd, Sm or Eu) type which had been previously discovered by Akimitsu et al. As

the Sr content, y , increased when $Ln = Ln(\text{excited state}) = Nd$, the oxygen content, z , monotonically increased and the superconducting transition temperature, $T_{sub c}$, varied exhibiting a maximum. When z was controlled directly by means of high oxygen pressure sintering techniques, $T_{sub c}$ was changed accordingly. $T_{sub c}$'s of samples with different combinations of Ln and $Ln(\text{excited state})$ and different values of x and y were found to depend on the magnitude of the bond valence sum for a Cu atom located in the bottom plane of the Cu-O5 pyramid. Transport and magnetization measurements were carried out to investigate the magnetic field dependence of superconducting properties and to determine the phenomenological parameters. The Hall coefficients were positive below room temperature and varied yielding a maximum with respect to temperature. Author

N92-21636* # International Superconductivity Technology Center, Tokyo (Japan). Superconductivity Research Lab.

COMPARATIVE STUDY OF FLUX PINNING, CREEP AND CRITICAL CURRENTS BETWEEN YBaCuO CRYSTALS WITH AND WITHOUT Y₂BaCuO₅ INCLUSIONS

MASATO MURAKAMI, SATOSHI GOTOH, HIROYUKI FUJIMOTO, NAOKI KOSHIZUKA, and SHOJI TANAKA /in NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 241-248 Jan. 1991

Avail: CASI HC A02/MF A04

In the Y-Ba-Cu-O system, YBa₂Cu₃O(x) phase is produced by the following peritectic reaction: Y₂BaCuO₅ + liquid yields 2YBa₂Cu₃O(x). Through the control of processing conditions and starting compositions, it becomes possible to fabricate large crystals containing fine Y₂BaCuO₅(211) inclusions. Such crystals exhibit J_c values exceeding 10000 A/sq cm at 77 K and 1T. Recently, researchers developed a novel process which can control the volume fraction of 211 inclusions. Elimination of 211 inclusions is also possible. In this study, researchers prepared YBaCuO crystals with and without 211 inclusions using the novel process, and compared flux pinning, flux creep and critical currents. Magnetic field dependence of J_c for YBaCuO crystals with and with 211 inclusions is shown. It is clear that fine 211 inclusions can contribute to flux pinning. It was also found that flux creep rate could be reduced by increasing flux pinning force. Critical current density estimates based on the conventional flux pinning theory were in good agreement with experimental results. Author

N92-21638* # Tokyo Univ. (Japan). Dept. of Industrial Chemistry.

OXIDE SUPERCONDUCTORS UNDER MAGNETIC FIELD

Abstract Only

K. KITAZAWA /in NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 257 Jan. 1991

Avail: CASI HC A01/MF A04

One of the current most serious problems for the oxide superconductors from the standpoint of practical application is the various novel features derived mainly from their extremely short coherence. In particular, the coherence length so far observed in the cuprate superconductors is in the range of 0.1 nm perpendicular to the CuO₂ plane. This seems to be creating most of the difficulties in the device fabrication and in the performance under the magnetic field. Some of the superconducting properties under the magnetic field will be discussed in terms of the short coherence length. A model will be presented based on the gradual strengthening of the pinning force with decrease in temperature and the weak coupling at the grain boundaries. Secondly, the broadening of the superconducting transition under the magnetic field is discussed. This is observed significantly only when the field is applied perpendicular to the basal plane and the relative orientation of the current to the field is insignificant in determining the extent of broadening. Besides, the change in the strength of the pinning force does not affect the width of the broadening. From these observations discussions will be made on a model based on the giant fluctuation. Based on this model, it is predicted that the coherence length along the c -axis will be the single most

important material parameter to determine the performance of the superconductor under a strong magnetic field. It seems that YBCO is superior in this regard to Bi- or Tl-systems as far as the performance at 77 K is considered, although another material with the coherence length slightly longer along the c -axis is still highly desired. Author

N92-21642* # Matsushita Electric Industrial Co. Ltd., Osaka (Japan). Central Research Labs.

PREPARATION AND CHARACTERISTICS OF SUPERCONDUCTING CUPRATE THIN FILMS: ND(2-X)CE(X)CUO₄ AND SUBSTRATED BI-SYSTEM

H. ADACHI, S. HAYASHI, K. SETSUNE, S. KOHIKI, Y. ICHIKAWA, and K. WASA /in NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 281-290 Jan. 1991

Avail: CASI HC A02/MF A04

Characteristics of the electron-doped-type Nd(sub 2-x)Ce(sub x)CuO₄ system and substituted Bi-system were studied using the high quality thin film samples grown by rf magnetron sputtering and/or subsequent heat treatment. The Nd(sub 2-x)Ce(sub x)CuO₄ samples with excellent superconducting properties were obtained in thin films and their optical and X-ray photoelectron spectroscopy (XPS) studies were performed with regard to the Ce content and reducing treatment. Substituted BiSr-Ln-Cu-O thin films were prepared and growth conditions for Bi-system with 2-2-1-2 and 2-2-2-2 phases were found. Moreover, a new 2-2-1-2 phase in the simple Bi-Sr-Cu-O system was fabricated by thin film processing and 80 K superconductivity was obtained. Author

N92-21647* # Fujitsu Ltd., Atsugi (Japan).

MAGNETIC RELAXATION IN THE 110 K SUPERCONDUCTING PHASE IN BI-SR-CA-CU-O THIN FILMS

ATSUSHI TANAKA, JASON CRAIN, NOBUO KAMEHARA, and KOICHI NIWA /in NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 319-322 Jan. 1991

Avail: CASI HC A01/MF A04

We have investigated the time dependence of remnant moment decay in a highly oriented, nearly single high $T_{sub c}$ phase Bi-Sr-Ca-Cu-O thin film. A strictly logarithmic time dependence was observed over a 20 K temperature range for observation intervals of 2000 seconds. The normalized decay rate exhibits a peak around 14 K and has a relatively weak magnetic field dependence. These data are then compared with existing data on the YBCO and Eu-based superconductors. Author

N92-21676* # International Superconductivity Technology Center, Tokyo (Japan). Superconductivity Research Lab.

PROGRESS OF RESEARCH OF HIGH-TC SUPERCONDUCTORS Abstract Only

SHOJI TANAKA /in NASA. Goddard Space Flight Center, AMSAHTS 1990: Advances in Materials Science and Applications of High Temperature Superconductors p 475 Jan. 1991

Avail: CASI HC A01/MF A04

Research in the area of high $T_{sub c}$ superconductors has made great progress in the last few years. New materials were found and the systematic investigation of these materials has contributed to understanding the mechanism of high $T_{sub c}$ superconductivity. The critical currents in thin films, bulks, and tapes increased drastically, and the origin of flux pinning will be clarified in the near future. The future of high $T_{sub c}$ superconductivity, in both the basic and applied research areas, is very optimistic. Recent activities in research of high $T_{sub c}$ superconductivity and superconductors in Japan are overviewed. Author

N92-25947* # National Inst. for Fusion Science, Nagoya (Japan).

TOTAL AND PARTIAL CROSS SECTIONS OF ELECTRON TRANSFER PROCESSES FOR BE(SUP Q+) AND B(SUP Q+) IONS IN COLLISIONS WITH H, H₂ AND HE GAS TARGETS

HIRO TAWARA Jun. 1991 91 p (DE92-768018; NIFS-DATA-12) Avail: CASI HC A05/MF A01

A review is given for the total and partial cross sections of electron transfer for $\text{Be}(\text{sup } q+)$ and $\text{B}(\text{sup } q+)$ ions in collisions with the important constituent targets in plasma devices such as H, H₂, and He. A short comment on electron transfer data in relation to recent observations of photons from $\text{Be}(\text{sup } q+)$ ions at JET tokamak is also given. DOE

N92-28282# Japan Atomic Energy Research Inst., Tokyo.

GADOLINIUM METASTABLE STATES POPULATION DISTRIBUTIONS AND ATOMIC DENSITY UNDER HIGH-RATE ELECTRON BEAM EVAPORATION

AKIHIKO NISHIMURA, TAKASHI ARISAWA, HIRONORI OHBA, and TAKEMASA SHIBATA Oct. 1991 19 p In JAPANESE; ENGLISH summary

(DE92-782008; JAERI-M-91-178) Avail: CASI HC A03/MF A01

Metastable states population distributions of gadolinium atoms under high-rate electron beam evaporation were measured by laser light absorption. The experiments were carried out under high atomic density of 10(exp 12) approximately 10(exp 13) atoms/cm(exp 3) at the light absorption zone and following several vapor characteristics were found: (1) the atomic excitation temperature derived from metastable states population distribution was considerably lower than the evaporation surface temperature and decreased with increasing the evaporation rate; (2) atomic vapor is almost free from the cluster formation caused by a rapid expansion into a high vacuum; and (3) the atomic density is in reciprocal proportion to the square of the distance from the evaporation surface. DOE

N92-33864# Fujitsu Ltd., Tokyo (Japan).

RESULT OF EXPERIMENTS BY GAS (GET AWAY SPECIAL): SEMICONDUCTOR CRYSTAL GROWTH EXPERIMENT IN MICROGRAVITY USING GAS PROGRAM

SHIGEO KODAMA, KINJI NISHIO, MASAHIRO TAKAYANAGI, HIROSHI NEMOTO, SHINICHI KITAMURA, YUICHI SUZUKI, OSAMU UEDA, OSAMU OOTSUKI, and KEN KOTANI /In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 147-159 21 Jan. 1992 In JAPANESE Avail: CASI HC A03/MF A02

Space manufacturing experiments utilizing the Get Away Special (GAS) program were conducted as pretests for future large scale space experiments. Crystal growth of PbSnTe and GaAs in microgravity using CVD (Chemical Vapor Deposition) and liquid phase epitaxy, respectively, were observed. The influence of epitaxy on the back of the substrate and the state of crystal growth on the substrate surface were observed using Scanning Electron Microscope (SEM). The surface configuration of substrates processed in space is flatter than the configuration of a substrate processed on the earth. It is also found that the surface flatness of the substrate depended on the crystal faces (Miller indices).

Author (NASDA)

N92-33865# Tokyo Univ. (Japan). Dept. of Electronic Engineering.

STATUS OF INTERNATIONAL CO-OPERATION. CASE STUDY: ELUCIDATION OF THE CAUSE AND CONTROL OF SECOND IMPURITY PATTERN IN SEMICONDUCTORS [KOKUSAI KYOURYOKU NI YORU JIKKEN SEIKA. KESU SUTADI: HANDOUTAI NI OKERU DAI 2 SHU FUJUNBUTSUJIMA NO KEISEI GENIN NO KAIMEI TO YOKUSEI]

TATAU NISHINAGA /In Science and Technology Agency, The 14th Space Station Utilization Workshop in Japan p 161-168 21 Jan. 1992 In JAPANESE Prepared in cooperation with Freiburg Univ., Fed. Republic of Germany Avail: CASI HC A02/MF A02

Cause and control of the 2nd impurity patterns in tellurium doped gallium antimonide and sulfur doped indium phosphide semiconductors were studied. The semiconductors were made using the Travelling Heater Method (THM) on Spacelab SL-1 (1983) and D-1 (1985). Samples were chemically etched and observed by spatial resolution photo luminescence method. As a result, the condition to control the formation of the 2nd impurity pattern is elucidated, and crystal growth without 1st or 2nd impurity patterns

can be obtained using the THM method in microgravity. Methods to remove the macrosteps formed by LPE (Liquid Phase Epitaxy), which is a method for the formation of semiconductor thin solids, are found. It is made clear that the latter result is attributable to ground technology improvement yielded by analyzing experiments in microgravity. It is made clear that accurate research on the formation and disappearance of 2nd impurity patterns and accurate measurement of physical constants, such as the diffusion coefficient, are possible in microgravity conditions due to lack of thermal convection. Author (NASDA)

THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

A92-10438

PRACTICAL EXPRESSIONS FOR THERMODYNAMIC AND TRANSPORT PROPERTIES OF COMMONLY USED FLUIDS

MASAO FURUKAWA (NASDA, Tsukuba Space Center, Japan) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 5, Oct.-Dec. 1991, p. 524-531. refs Copyright

Expressions are derived that can be used to facilitate the evaluation of thermophysical property values of saturated fluids and compressed liquids. The expressions are dependent on temperature or temperature and pressure and are employed to describe the properties of ammonia, water, propane, and other liquids totalling 14 saturated fluids and 10 compressible liquids. The data derived are of significant value for the calculation of design shapes for heat pipes and fluid loops. C.C.S.

A92-10583

A DIRECT NUMERICAL APPROACH TO THE CHANDRASEKHAR'S H-FUNCTIONS FOR ARBITRARY CHARACTERISTIC FUNCTIONS

KIYOSHI KAWABATA, TAKEHIKO SATOH (Tokyo, Science University, Japan), and SUEO UENO (Kyoto School of Computer Science, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 182, no. 2, Aug. 1991, p. 249-260. refs Copyright

The purpose of this paper is to present a numerical technique to directly compute the Chandrasekhar's $H(\mu)$ -function for anisotropic scattering in terms of the roots of the characteristic equation as well as the quadrature points of a certain degree n employed to approximate the definite integral involved in the basic equation. The principal feature of the proposed algorithm is a compact computer code to enumerate nC_m combinations of n distinct integers $(l_1, \dots, l_n)$ taken m at a time. With these quantities available, the coefficients of the polynomial equation of the characteristic equation can be readily computed for any given characteristic function, so that a standard technique such as the Laguerre method can be applied to find all the roots. It is shown that the results obtained for some representative $H(\mu)$ -functions using the present technique with relatively low-order formula (e.g., $n = 7$) are sufficiently accurate for all practical purposes.

Author

A92-21236

NUMERICAL ANALYSIS OF STEADY FLOWS OF A GAS EVAPORATING FROM ITS CYLINDRICAL CONDENSED PHASE ON THE BASIS OF KINETIC THEORY

HIROSHI SUGIMOTO and YOSHIO SONE (Kyoto University, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, Feb. 1992, p. 419-440. refs Copyright

Steady evaporating flows from a cylindrical condensed phase in an infinite expanse of its vapor gas are investigated numerically

on the basis of the Boltzmann-Krook-Welander equation. Not only the mass flow rate and the energy flow rate from the cylinder, but also the local variables of the gas over the whole flow field are obtained for a wide range of the Knudsen number and the pressure ratio, which is defined by the pressure at infinity divided by the saturation gas pressure at the temperature of the condensed phase. The acceleration of gas flows, especially to a supersonic flow, near the cylinder and the deceleration to the stationary state at infinity are clarified. The discontinuity of the velocity distribution function in the gas, a typical behavior of a gas around a convex body, is analyzed accurately with the difference scheme devised for this purpose, and its relation to the S layer described by Sone (1973) is discussed. Author

A92-26122

THERMODYNAMICAL BEHAVIOUR OF LIQUID WATER NEAR THE TRIPLE POINT

SIZUKA KURIOKA and KAZUYOSI IKEDA (Osaka University, Suita, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Dec. 1991, p. 4181-4198. refs
Copyright

A 1D gas model and experimental data are utilized to theoretically examine the anomalous thermodynamical behavior of water near the triple point. Attention is given to the regions in which the pressure coefficient is negative (in the temperature-volume plane) and in which the thermal expansivity is negative (in the pressure-temperature plane) of the thermodynamical diagrams. Logical explanations are provided based on the 1D model that describe the anomalous behavior of the pressure-volume isotherms and have implications for the molecular-theoretical interpretations of the same properties. C.C.S.

A92-30123

NUMERICAL APPROACH TO ZEEMAN LINE RADIATIVE TRANSFER

YOICHI TAKEDA (Tokyo, University, Mitaka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. 719-737. refs
Copyright

An accelerated lambda iteration (ALI) method, a version of the operator perturbation technique, is formulated for applications to Zeeman line formation problems in the presence of magnetic fields. This approach has proven to be quite an effective and flexible numerical device, being applicable to extensive problems (e.g., LTE one-way integration problem, noncoherent scattering etc.). In addition to its general formulation, a specialized practical version is also proposed which is limited to scattering (or multi-level) problems under the assumption of complete frequency redistribution (CRD), but requiring much less computing time. In order to examine the computational efficiency of this ALI method, numerical examples are presented concerning line formation in a magnetic field for several simple cases (LTE Milne-Eddington model, noncoherent CRD scattering, angle-dependent coherent scattering), showing a reasonably rapid convergence with notable numerical stability. Comparisons with other recent numerical techniques confirm the distinguished superiority of the present method. Author

A92-30507

APPLICATION OF THE NULL COLLISION DIRECT SIMULATION MONTE CARLO METHOD

TAKASHI ABE (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 14-17. In Japanese. refs

In the direct simulation Monte Carlo method, the Nanbu method and Koura's null collision are addressed. Three kinds of collision sampling techniques, the time counter (TC), the collision (NC), and the no time counter (NTC) methods are presented. Kac's master equation is used for the comparison among the existence simulations. Y.P.Q.

A92-30508

USING THE DIRECT SIMULATION MONTE CARLO TIME COUNTER (TC) METHOD FOR ABNORMAL COLLISION FREQUENCY PHENOMENA

TAKASHI ABE (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 18-21. In Japanese.

A92-30509

DIRECT SIMULATION MONTE CARLO IN CORRECT NUMERICAL CALCULATION OF COLLISION

KATSUHIKA KOURA (National Aerospace Laboratory, Chofu, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 22, 23. In Japanese. refs

Koura's null collision (NC) and Bird's time counter (TC) methods are presented. The time variation and dependence of mean value and standard deviations obtained by the NC and TC techniques are examined. Y.P.Q.

A92-30533

STUDY OF RAREFIED GAS DYNAMICS USING THE MAXWELL EQUATIONS

TOSHIICHI TSUMIE and RYUJI FUJINUMA (Tsukuba University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 120-123. In Japanese. refs

A mathematical analysis of rarefied gas dynamics is presented. Boltzmann equations are given and the Pirani vacuumeter is used in an experiment on the heat flow. Y.P.Q.

A92-30535

NONLINEAR ANALYSIS OF EVAPORATION AND CONDENSATION FOR A VAPOR-GAS MIXTURE BETWEEN TWO PLANE CONDENSED PHASES. II - ANALYSIS BASED ON FLUID-DYNAMIC EQUATIONS

YOSHIMOTO ONISHI (Tottori University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 128-131. In Japanese. refs

A92-30536

ON EVAPORATION AND CONDENSATION OF A POLYATOMIC MOLECULAR GAS FLOW

T. SOGA (Nagoya University, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 132-135. In Japanese. refs

A92-30537

ELEVATED EVAPORATION FROM PLANE CONDENSATION IN MIXED GAS FLOWS

YOSHIMOTO ONISHI, T. KAWAMURA (Tottori University, Japan), and H. MIURA (Kinki University, Higashiosaka, Japan) IN: Fluid Dynamics Conference, 22nd, Osaka, Japan, Nov. 15, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 136-139. In Japanese. refs

A92-32918

THERMODYNAMIC FORMULAS OF LIQUID PHASE NUCLEATION FROM VAPOR IN MULTICOMPONENT SYSTEMS

K. NISHIOKA and I. KUSAKA (Tokushima, University, Japan) Journal of Chemical Physics (ISSN 0021-9606), vol. 96, April 1, 1992, p. 5370-5376. refs
(Contract MOESC-0324310)
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In an attempt to determine whether or not the size and composition dependence of interfacial tension must be taken into account in taking the extremity condition of the reversible work to derive the size and composition of a critical nucleus, interfacial thermodynamics is extended to a noncritical liquid cluster in equilibrium with the vapor. The role of the Gibbs-Duhem relation

in this problem is considered. It is found that the differential of the interfacial tension does not arise in the differential of the reversible work due to the Gibbs-Duhem relation for the system. The extremity condition for the reversible work of forming a noncritical cluster results in the Gibbs formula which represents the condition of a critical nucleus. V.L.

A92-34019

NONHYDROSTATIC AND NONEQUILIBRIUM THERMODYNAMICS OF DEFORMABLE MATERIALS

ICHIKO SHIMIZU (Tokyo, University, Japan) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, no. B4, April 10, 1992, p. 4587-4597. refs
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The nonequilibrium thermodynamics of polycrystalline solids under nonhydrostatic stress are formulated, based on the conservation laws of classical dynamics and the second law of thermodynamics. For a closed system, the thermodynamic potential function corresponding to the Gibbs free energy, in classical thermodynamics, is defined as a Legendre transformation of the internal energy of the system, whereas it cannot be defined in an open system under stress. Chemical potential is defined at source points where addition of matter is possible. Chemical potential for grain growth ($\mu +$) under nonhydrostatic stress varies with the orientation of grain surfaces and with direction of grain growth. Pressure solution, diffusion creep, and anisotropic phase equilibrium under stress are explained by the orientation dependence of ($\mu +$). Author

A92-37968

LOG-GAMMA DISTRIBUTION MODEL OF INTERMITTENCY IN TURBULENCE

YOSHIO SAITO (Toho University, Tokyo, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 2, Feb. 1992, p. 403-406. refs
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Homogeneous isotropic turbulence with very large Reynolds numbers is considered in a theoretical treatment of the log-gamma distribution model of intermittency. When scale similarity is assumed the probability distribution for the logarithm of the breakdown coefficient of energy-dissipation density is infinitely divisible. This allows the expression of the intermittency exponent of the breakdown coefficient in a manner that is supported by experimental and analytical data. C.C.S.

A92-49495

STATISTICAL INELASTIC CROSS-SECTION MODEL FOR THE MONTE CARLO SIMULATION OF MOLECULES WITH DISCRETE INTERNAL ENERGY

KATSUHIKA KOURA (National Aerospace Laboratory, Chofu, Japan) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 8, Aug. 1992, p. 1782-1788. refs
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The statistical inelastic cross-section (SICS) model based on the statistical uncorrelation assumption is derived using the microscopic reversibility relation for the Monte Carlo simulation of molecules with discrete internal energy. The SICS model is specified for rotationally inelastic collisions by employing Parker's rotational energy gain function and applied to the calculation of the rotational distribution through a nitrogen shock wave with the null-collision direct-simulation Monte Carlo method. It is shown that the SICS model produces the Boltzmann and bimodal rotational distributions in low and high Mach number shock waves, respectively, consistent with the experimental results of Robben and Talbot (1966). Author

A92-50971

INSTABILITY AND PHASE SEPARATION OF A BINARY MIXTURE - THE ROLE OF SHORT-RANGE REPULSION AND CORE-SIZE RATIO

SHAW KAMBAYASHI (Japan Atomic Energy Research Institute, Tokai) and YASUAKI HIWATARI (Kanazawa University, Japan) Physical Review A (ISSN 1050-2947), vol. 46, no. 2, July 15,

1992, p. 1014-1021. Research supported by MOESC and Oesterreichischer Forschungsfonds. refs
Copyright

The mixing properties of binary soft-sphere mixtures of inverse-power potentials with different inverse-power parameters are studied by means of a generalized van der Waals model. Pair-distribution functions are used to calculate the concentration-concentration structure factor to study phase separation and other conditions of stability. The analysis provides insight into the thermodynamical stability of binary mixtures under normal and supercooled fluid conditions. C.C.S.

A92-52705

EXACT SOLUTIONS OF A STOCHASTIC MODEL OF EXTENDED KINETIC THEORY

GIAMPIERO SPIGA (Kyoto University, Japan; Bari, Università, Italy) and KAZUO AOKI (Kyoto University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 30-37. Research supported by CNR, Japan Society for the Promotion of Science, and MPI. refs
Copyright

A stochastic model of extended kinetic theory, allowing for removal interactions and background medium, is investigated in the space inhomogeneous case. Exact particular solutions depending on time and on a space coordinate are discussed in the conservative case, mainly by Lie group theoretical methods. A family of physically meaningful soliton solutions of shock wave type, with different propagation speeds and asymptotic limits, is determined. Author

A92-52710

FLUID DESCRIPTION OF KNUDSEN LAYERS AND APPLICATIONS TO THE PIRANI GAUGE PROBLEM

SHUNICHI TSUGE, RYUJI FUJINUMA, and MAKI NOMURA (Tsukuba, University, Japan) IN: Rarefied gas dynamics; Proceedings of the 17th International Symposium, Aachen, Germany, July 8-14, 1990. Weinheim, Germany and New York, VCH Verlagsgesellschaft mbH, 1991, p. 93-100. refs
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An attempt is made to extend the validity limit of fluid dynamics toward larger Knudsen numbers. It is effected by employing an 18-moment generating function to incorporate far-reaching wall effect into the Boltzmann function to replace the classical 13-moment expansion, and by formulating molecular continuity condition at a solid wall in the μ -space. Taking moments of each of these equations, from Knudsen layer corrections to the transport formula of the Fourier laws and from boundary conditions governing velocity slip, the temperature jump, molecular reflectivity and population of diffuse reflection at the wall are obtained. These make problems of fluid dynamics under rarefied circumstances well-posed, and problems related to the Pirani gauge heat transfer are solved in this light. Author

A92-53076

ANALYSIS OF THERMAL STRESS SLIP FLOW AND NEGATIVE THERMOPHORESIS USING THE BOLTZMANN EQUATION FOR HARD-SPHERE MOLECULES

T. OHWADA and Y. SONE (Kyoto University, Japan) European Journal of Mechanics, B/Fluids (ISSN 0997-7546), vol. 11, no. 4, 1992, p. 389-414. refs
Copyright

The thermal stress slip flow is analyzed on the basis of the standard Boltzmann equation for hard-sphere molecules. For this purpose, the explicit form of the Grad-Hilbert expansion of the Boltzmann equation is obtained up to the second order in the Knudsen number. The results suggest that negative thermophoresis occurs for a hard-sphere molecular gas under the Maxwell-type boundary condition as well as for the Boltzmann-Krook-Welander model under the same boundary condition. V.L.

N92-15844# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

VARIOUS ACTIONS FOR PREGEOMETRY

HIDEZUMI TERAZAWA Apr. 1991 13 p

(DE91-508416; INS-869) Avail: CASI HC A03/MF A01

Various actions for pregeometry are presented and compared. The 'space-field identity' which equates the n-beins to the derivatives of fundamental scalars is derived from a simple action but seems to be too restrictive to be practical. DOE

N92-15847# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

UNIVERSALITY OF THE MATRIX MODEL APPROACH TO TWO-DIMENSIONAL QUANTUM GRAVITY

F. P. ZEN Feb. 1991 13 p

(DE91-508170; YITP/U-91-16) Avail: CASI HC A03/MF A01

Universality with respect to triangulations is investigated in the hermitian one-matrix model approach to 2-D quantum gravity for a potential containing both even and odd terms, $V(\phi) = 1/2\phi(\exp 2) + (g(\text{sub } 3)/3 \text{ sq. root of } N)\phi(\exp 3) + (g(\text{sub } 4)/4N)(\phi(\text{sup } 4))$. With the use of analytical and numerical calculations, I find that the universality holds and the model describes pure gravity, which lead in the double scaling limit to coupled equations of Painleve type. DOE

N92-16926# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

REGULARIZATION OF QUANTUM GRAVITY IN THE MATRIX MODEL APPROACH

HARUHIKO UEDA (Hiroshima Univ., Japan) Feb. 1991 10 p

(DE91-508172; YITP/U-91-15) Avail: CASI HC A02/MF A01

We study the divergence problem of the partition function in the matrix model approach for two-dimensional quantum gravity. We propose a new model $V(\phi) = 1/2\text{Tr } \phi(\exp 2) + g \text{ sub } 4/N \text{ Tr } \phi \text{ sup } 4 + g(\exp 1)/N(\text{sup } 4)\text{Tr}(\phi(\exp 4))(\exp 2)$ and show that in the sphere case it has no divergence problem and the critical exponent is of pure gravity. DOE

N92-16927# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

NAMBU-GOTO ACTION IN D=2 AND TOPOLOGICAL FIELD THEORIES

KAZUO FUJIKAWA, JISUKE KUBO, and HARUHIKO TERAOKA Feb. 1991 14 p

(DE91-508177; YITP/U-91-13) Avail: CASI HC A03/MF A01

The Nambu-Goto theory in D=2 dimensions is canonically transformed to study topological aspects of the theory. Using the Batalin-Fradkin-Vilkovisky formalism, it is shown that the transformed theory, which is quantum mechanically consistent, is related to various topological theories in two dimensions including topological gravity. It is emphasized that the bosonic coordinates $X(\exp a)(\tau, \sigma)$ play quite different roles in string theory and in topological theory. DOE

N92-16928# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

A NOVEL SUPERSYMMETRY IN 2-DIMENSIONAL YANG-MILLS THEORY ON RIEMANN SURFACES

JIRO SODA (Hiroshima Univ., Japan) Feb. 1991 11 p

(DE91-508180; YITP/U-91-12) Avail: CASI HC A03/MF A01

We find a novel supersymmetry in 2-dimensional Maxwell and Yang-Mills theories. Using this supersymmetry, it is shown that the 2-dimensional Euclidean pure gauge theory on a closed Riemann surface (Sigma) can be reduced to a topological field theory which is the 3-dimensional Chern-Simons gauge theory in the special space-time topology Sigma x R. Related problems are also discussed. DOE

N92-16929# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

AXIALLY SYMMETRIC DOMAIN WALL IN 2+1-DIMENSIONS

JIRO SODA and YUKI YAMANAKA Apr. 1991 11 p

(DE91-508411; YITP/U-91-20) Avail: CASI HC A03/MF A01

An axially symmetric domain wall (string) in 2+1-dimensions is investigated in the synchronous gauge. This problem is also regarded as a cylindrical symmetric domain wall (membrane) in 3+1-dimensions. Using Israel's method, we present a general solution. As a special case, a static solution is obtained which agrees with the previous result of Deser and Jackiw obtained by another method. DOE

N92-17817# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

FUTURE PROSPECTS OF PREGEOMETRY

HIDEZUMI TERAZAWA Jun. 1991 19 p

(DE92-704278; INS-879) Avail: CASI HC A03/MF A01

Pregeometry is a theory, first suggested by Sakharov in 1967, in which gravity is taken as a quantum effect of matter fields and in which Einstein's theory of general relativity for gravity appears as an approximate and effective theory at long distances. It is shown by reviewing the extensive developments of pregeometric theories of gravity for the last more than a decade that the original idea by Sakharov is really working. Many future prospects of the theories are discussed in some detail. DOE

N92-22975# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

NON-PERTURBATIVE EFFECT OF A MODIFIED ACTION IN MATRIX MODELS

SHIRO SAWADA and HARUHIKO UEDA May 1991 10 p

(DE92-750832; YITP/U-91-24) Avail: CASI HC A02/MF A01

A modified matrix model action, which may provide the well-defined two dimensional pure gravity theory, proposed by Das, Dhar, Sengupta and Wadia is analyzed non-perturbatively. The perturbative solution in genus expansion is also obtained. It is shown that the specific heat satisfies Painleve equation in the double scaling limit. Thus the modified action is found to be in the same universality class as ordinary matrix models. DOE

N92-25948# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

TOPOLOGICAL FIELD THEORY OF FOUR DIMENSIONAL SELF-DUAL GRAVITY AND TWISTED HARMONIC SUPERSPACE

KEI ITO Sep. 1991 12 p

(DE92-768072; INS-893) Avail: CASI HC A03/MF A01

A topological invariant version of a self-interacting N=4 harmonic superfield model is constructed. It is shown that the theory describes the 'topological phase' of four dimensional self-dual gravity. DOE

N92-26985# Japan Systems Corp., Kawasaki.

THERMAL ANALYSIS OF EVAPORATIVE COOLERS

MASATOSHI OHUCHI (Japan Systems Corp., Kawasaki.), MASAO FURUKAWA (National Space Development Agency, Ibaraki, Japan), and KOICHI OSHIMA In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 2 p 851-854 Dec. 1991

Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

In order to develop the conceptual design of the Thermal Control System (TCS) of HOPE (Japanese orbiting plane planned to be launched by H2 rocket), the thermal model of the evaporative cooling system of the U.S. Space Shuttle was analyzed. This consists of Flash Evaporator Subsystem (FES) at high altitude and Ammonia Boiler Subsystem (ABS) at low altitude, both of which are for cooling of the freon loops, and Water Spray Boiler Subsystem (WSB), for cooling of the oil loops. Simplified thermal models of these devices were constructed based in the reported data such as the geometries and the design requirements. The simulated results based on these thermal models were compared with the Shuttle postflight data. Integration of these subsystem models into the total TCS model is underway. ESA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

N92-28235# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.

PROCEEDINGS OF THE WORKSHOP ON QUANTUM GRAVITY AND TOPOLOGY

ICHIRO ODA, ed. Oct. 1991 186 p Workshop held in Tanashi, Japan, 21-23 Feb. 1991

(DE92-782191; INS-T-506; CONF-9102158) Avail: CASI HC A09/MF A02

The workshop on Quantum Gravity and Topology was held at INS on February 21-23, 1991. Several introductory lectures and more than 15 talks were delivered for about 100 participants. The main subjects discussed were: (1) topological quantum field theories and topological gravity; (2) low dimensional and four dimensional gravity; (3) topology change; and (4) superstring theories etc.

DOE

N92-70544 Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

AFFINE TODA FIELD THEORY: S-MATRIX VERSUS PERTURBATION

H. W. BRADEN (Edinburgh Univ., Scotland), E. CORRIGAN, P. E. DOREY, and R. SASAKI Jan. 1991 16 p

(DE92-750828; YITP/U-91-4) Avail: CASI HC A03/MF A01

We have given several pieces of evidence that perturbation theory manages to reproduce various salient features of the conjectured exact S-matrices of ATFT. At present, we do not see how to use perturbation theory to provide an efficient description of the quantum field theory; an alternative formulation may well be required in order to find a proper understanding of the conjectured S-matrices and other features such as the mass-renormalization and the Clebsch-Gordan property. Certainly, the knowledge from other approaches, for example, the Quantum Group approach to imaginary coupling ATFT, investigations of the Bethe-Salpeter equations for the bound states in ATFT and the algebraic Bethe ansatz method advocated for many years by Faddeev and others would be helpful in the search for such a reformulation.

DOE

N92-70551 Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

ON MATRIX REALIZATION OF RANDOM SURFACES

MISAO SASAKI and HIROSHI SUZUKI Dec. 1990 35 p (DE92-750826; YITP/U-90-29) Avail: CASI HC A03/MF A01

The large N one-matrix model with a potential, $V(\phi) = \phi(\exp 2)/2 + g(\text{sub } 4)\phi(\exp 4)/N + g(\text{sub } 6)\phi(\exp 6)/N(\exp 2)$ is carefully investigated using the orthogonal polynomial method. We present a numerical method to solve the recurrence relation and evaluate the recursion coefficients $r(\text{sub } k)$ ($k = 1, 2, 3, \dots$) of the orthogonal polynomials at large N . We find that for $g(\text{sub } 6)/g(\text{sub } 4)(\exp 2)$ greater than $1/2$ there is no $m = 2$ solution which can be expressed as a smooth function of k/N in the limit N yields infinity. This means that the assumption of smoothness of $r(\text{sub } k)$ at N yields infinity near the critical point, which was essential to derive the string susceptibility and the string equation, is broken even at the tree level of the genus expansion by adding the $\phi(\exp 6)$ -term. We have also observed the free energy around the (expected) critical point to confirm that the system does not have the desired criticality as pure gravity. Our (discouraging) results for $m = 2$ are complementary to previous analyses by the saddle point method. On the other hand, for the case $m = 3$ ($g(\text{sub } 6)/g(\text{sub } 4)(\exp 2) = 4/5$), we find a well-behaved solution which coincides with the result by Brezin et al. To strengthen the validity of our numerical scheme, we present in appendix a non-perturbative solution for $m = 1$ which obeys the so-called type-II string equation proposed by Demeterfi et al.

DOE

N92-70552 Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

CONFORMAL FIELD THEORETICAL APPROACH TO TWO-DIMENSIONAL QUANTUM GRAVITY

HIROSHI SUZUKI (Hiroshima Univ., Japan) Jan. 1991 35 p (DE92-750831; YITP/U-91-7) Avail: CASI HC A03/MF A01

A conformal (or Weyl) mode of two-dimensional gravity coupled

to conformally invariant matter, which is a gauge degree of freedom in the classical level, becomes dynamical through the conformal (or Weyl) anomaly. We consider the BRS quantization of the above system in the conformal gauge. As a practical approach which enables us to do explicit calculations, we reduce the BRS invariant path integral measure for the conformal mode to the naive one by including a one-loop renormalization effect. Since the two-dimensional metric is locally conformally flat, the resulting effective theory is constructed in a flat space-time. We also construct tensorial operators (BRS, ghost number current, and the energy momentum tensor) in the effective theory in a flat space-time based on anomalous Ward identities, i.e., trace, BRS, and ghost number anomalies. Then, we show that the effective theory has desired properties by calculating the operator product expansions. For example, we see that the total central charge of the Virasoro algebra vanishes. Our result forms a basis of a conformal field theoretical approach to two-dimensional quantum gravity and it has applications to a theory of non-critical strings.

DOE

80

SOCIAL SCIENCES (GENERAL)

Includes educational matters.

A92-55826

EDUCATION - THE CORNERSTONE OF MANNED PLANETARY MISSIONS

F. M. FRIEDLAENDER (Lockheed Research Laboratories, Palo Alto, CA) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 4 p.

(IAF PAPER 92-0501) Copyright

The development of a manned planetary mission is argued to be founded on and beneficial to the support of higher education. Education is shown to be a significant means for building a constituency for space exploration and utilization. An international exchange of interns is proposed for disseminating information and developing hardware for multinational space programs.

C.C.S.

81

ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

A92-22480

JAPANESE STATUS OF COMMERCIAL SPACE ACTIVITIES

JIRO KOCHIYAMA and HIROSHI IMAMURA (Rocket System Corp., Tokyo, Japan) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 9 p.

(IAF PAPER 91-651) Copyright

The Japanese space industry is described in terms of its nonmilitary basis and commercial developments to evaluate prospects for the near future. The industry is based on the interconnections between space-related service businesses, manufacturing businesses, and businesses based on the utilization of space. Descriptions are given of the country's current launch services, the manufacturing of vehicles, and developments in the areas of satellite communications and broadcasting. Remote sensing and materials processing are given as examples of space-environment utilization and establish the basis for areas of expansion. Space-related commerce is not considered to be economically significant although the activities of the industry are broadening at present.

C.C.S.

A92-46014

EMPLOYEE INVOLVEMENT IN QUALITY IMPROVEMENT - A COMPARISON OF AMERICAN AND JAPANESE MANUFACTURING FIRMS OPERATING IN THE U.S

MALING EBRAHIMPOUR (Rhode Island, University, Kingston) and BARBARA E. WITHERS (Old Dominion University, Norfolk, VA) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. 39, no. 2, May 1992, p. 142-148. refs
Copyright

The study determines whether firms classified as incorporating a Japanese quality management approach had significantly higher levels of worker involvement in the quality effort as well as higher utilization of statistical quality control (SQC) tools. The three types of firms represented were traditional American firms, Japanese firms operating in the U.S., and nontraditional American firms (firms emulating the Japanese approach to quality management). Results suggest that Japanese and nontraditional American firms have a significantly higher level of worker involvement and use simple SQC tools to a significantly higher degree than traditional American firms. Japanese firms operating in the U.S. showed results comparable to these American firms practicing Japanese quality management techniques. P.D.

N92-15911# National Science Foundation, Washington, DC. **INTERNATIONAL SCIENCE AND TECHNOLOGY DATA**

UPDATE: 1991

DEBORAH R. CICHON Apr. 1991 139 p *Its Surveys of Science Resources Series* (NSF-91-309) Avail: CASI HC A07/MF A02

This is the 1990 edition of an annual publication designed to provide quick reference to quantitative information on international science and technology (S&T) resource indicators. Charts and summary highlights compare S&T data for the European Community and seven major industrialized countries - France, West Germany, Italy, Japan, Sweden, the United States, and the United Kingdom. Graphic representations and explanatory paragraphs are presented on the left-hand pages of the report; supporting data are in the tables opposite. New S&T indicators and data for Italy and Sweden are presented in this issue for the first time. The statistics include data on national expenditures in research and development, human resources for science and technology, and research outputs, including publications and productivity. J.P.S.

82

DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

A92-19431* Lockheed Missiles and Space Co., Palo Alto, CA. **SOLAR-A REFORMATTED DATA FILES AND OBSERVING LOG**

M. D. MORRISON, J. R. LEMEN, L. W. ACTON (Lockheed Research Laboratories, Palo Alto, CA), R. D. BENTLEY (London, University College, Dorking, England), T. KOSUGI, S. TSUNETTA (Tokyo, University, Mitaka, Japan), Y. OGAWARA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and T. WATANABE (National Astronomical Observatory, Tokyo, Japan) Solar Physics (ISSN 0038-0938), vol. 136, Nov. 1991, p. 105-110. (Contract NAS8-37334)
Copyright

An overview is presented of the Solar-A telemetry data files which are to be created and the format and organization which the files are to use. The organization chosen is to be efficient in space, to facilitate access to the data, and to allow the data to be transportable to different machines. An observing log file is to be created automatically, using the reformatted data files as the input. It will be possible to perform searches with the observing log to list cases where instruments are in certain modes and/or

seeing certain signal levels. A user will be able to search the observing log and obtain a list of all cases where a given set of conditions are satisfied. An event log will be created listing the times when the instrument or spacecraft modes change. P.D.

A92-46450

COLLECTION DEVELOPMENT AND TECHNICAL PROCESSING OF PRIMARY INFORMATION RESOURCES

HIROTOYO ISHII (University of Library and Information Science, Tsukuba, Japan) Journal of Information Processing and Management (ISSN 0021-7298), vol. 35, no. 2, May 1992, p. 129-143. In Japanese. refs

Collection development and technical processing of primary information resources in information centers of private enterprises are described. The kinds and characteristics of primary information resources are outlined. One of the basic policies of information management is explained as combining two ways of information service: acquiring the information materials into the organization and seeking information from outside when required by users. Understanding user needs is also very important to information management. The basic arrangement of materials, ways of searching for materials, and the structure and work flow of technical processing are summarized. As one of the current aims of utilizing computer technology, serving information to users is stressed. Author

A92-55759

TOWARD CONSTRUCTING MULTI-LINGUAL DICTIONARY DATA BASE

J. MATSUKATA, T. HASHIMOTO, and J. KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p. refs
(IAF PAPER 92-0344) Copyright

The problems that will have to be solved in creating a database of multilingual aerospace terminology are examined, and solutions to these problems are proposed in the context of the state-of-the-art and current trends of computer science. The problems discussed include the handling of different types of characters, including European alphabets and Japanese and Chinese characters, on the same computer system, the problem of word correspondence among different languages, and the sorting order. Conditions for a proper multilingual dictionary base for aerospace terminology are formulated. V.L.

A92-55765

PROBLEMS IN COMPUTER-AIDED EDITION OF AEROSPACE MULTILINGUAL DICTIONARY IN JAPAN

JUN'ICHIRO KAWAGUCHI, TATSUAKI HASHIMOTO, SHUJIRO SAWAI, KEIKEN NINOMIYA, RYOJIRO AKIBA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and HISASHI SAEKI (Saint Maria Medical University, Kawasaki, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 8 p.
(IAF PAPER 92-0355) Copyright

The problems involved in the creation of an aerospace multilingual dictionary are summarized, and it is shown how these problems have been solved in compiling such a dictionary in computerized form in Japan. The problems discussed relate to the differences between Japanese and European characters, word correspondence among different languages, and sorting order. Despite the difficulties involved, the Japanese version of the dictionary has been edited using personal computers. A data base has also been constructed for English, French, and Japanese terminologies. V.L.

A92-55768

ADDITIONAL TERMINOLOGY DEFINITIONS

JUN'ICHIRO KAWAGUCHI, RYOJIRO AKIBA, TATSUAKI HASHIMOTO (Institute of Space and Astronautical Science, Sagami-hara, Japan), and HISASHI SAEKI (Saint Maria Medical University, Kawasaki, Japan) IAF, International Astronautical

82 DOCUMENTATION AND INFORMATION SCIENCE

Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 3 p.
(IAF PAPER 92-0361) Copyright

Definitions are presented for some of the undefined terms shown by the International Academy of Aeronautics (IAA). The terms defined here include active homing guidance, ascent, auxiliary power unit, ballistic flight, BAPTA, boiloff, divergent nozzle, flameout, expendable launch vehicle, graveyard orbit, and solar sailing. V.L.

A92-55769

DEFINITION OF UNDEFINED ASTRONAUTICAL TERMINOLOGIES

KEIKEN NINOMIYA, TATSUAKI HASHIMOTO, JUN'ICHIRO KAWAGUCHI, and RYOJIRO AKIBA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 3 p. refs

(IAF PAPER 92-0362) Copyright

There are some undefined words which are selected for the IAA Basic List of astronautical terminology. Definitions of those words are proposed, and some comments for them are also described in order to discuss how to refine them. Author

N92-17787# National Aerospace Lab., Tokyo (Japan). Kakuda Research Center.

MAKING OF FUNCTIONALLY GRADIENT MATERIALS DATA BASE (KEISHA KINO ZAIRYO DETA BESU NO SAKUSEI)

TAKAYUKI SUDO (National Aeronautical Lab., Tokyo (Japan).), KATSUTO KISARA (National Aeronautical Lab., Tokyo (Japan).), AKIO MORO (National Aeronautical Lab., Tokyo (Japan).), MASAYUKI NIINO (National Aeronautical Lab., Tokyo (Japan).), and YOSHITSUGU ISHIBASHI (Nippon Kokan Co. Ltd., Tokyo, Japan) Jun. 1990 39 p In JAPANESE (ISSN 0452-2982)

(NAL-TM-621; JTN-92-80292) Avail: CASI HC A03/MF A01

In order to satisfy the severe requirements for super heat resistant materials to be used in spaceplanes or nuclear fusion reactors, the functionally gradient materials (FGM), which use ceramics on the high temperature side and metals on the low temperature side, have been developed. The FGM database has been developed for the use of designers, material control teams, and evaluation team of the material. The features and structures of this database are shown in this report. Author (NASDA)

N92-31859# Japan Atomic Energy Research Inst., Tokyo.
CORRESPONDENCE DICTIONARY FROM FREE ENGLISH TERM TO INIS DESCRIPTORS

Dec. 1991 103 p

(DE92-782192; INIS-JP-002) Avail: CASI HC A06/MF A02

This dictionary is intended for the on-line users of the INIS database who select controlled terms (INIS descriptors) starting from free terms. The purpose of terminology control is (1) to reduce the ambiguity of the term use among different subject fields, and (2) to improve the recall by coordinating the synonyms. The controlled terms are collected in the thesaurus, but it is not always easy to find suitable descriptors. This dictionary was compiled by analyzing existing records, and provides the specialists' know-how of converting free terms to descriptors. The 5,000 records in the physics field were selected, and analyzed by the physicists from the Department of Physics, Ibaraki University. Besides the compilation of this dictionary, the characteristics of the assigned descriptors were also clarified. DOE

83

ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

A92-45150

THE LASER MARKETPLACE 1992; PROCEEDINGS OF THE SEMINAR, LOS ANGELES, CA, JAN. 22, 23, 1992

GARY T. FORREST, ED. (FYI Reports, Redwood City, CA) and MORRIS R. LEVITT, ED. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 1719), 1992, 186 p. No individual items are abstracted in this volume. (SPIE-1719; ISBN 0-8194-0886-7) Copyright

The present conference on trends and directions in the worldwide market for lasers encompasses an overview of the laser marketplace and addresses issues of interest to such specific markets as those for industrial laser uses, medical laser applications, and laser materials. Specific issues addressed include emerging laser technologies including electrophotographic applications and R&D applications of diode-pumped solid-state lasers, and attention is given to mergers and acquisitions in the laser and laser-related industries. Also addressed are the present climate and outlook for laser markets in Asia as a whole and more specifically in Japan and China. C.C.S.

84

LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

A92-20582

PROSPECTS FOR ORGANIZING INTERNATIONAL COOPERATION IN SPACE IN THE PACIFIC BASIN

BRENDA FORMAN (Lockheed Corp., Calabasas, CA) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. refs

(IAF PAPER 91-621) Copyright

Some areas of mutual interest that could form the basis for a regional cooperative institution in the Pacific Basin are explored. A possible model for such an organization might be ESA, whose members pursue independent national space programs while at the same time participating in ESA's multinational programs. Major question areas that arise when applying the ESA model in the context of the Pacific Basin are discussed. R.E.P.

A92-20599

THE MEANING OF JAPAN'S SPACE COMMERCIALIZATION EFFORTS

HIROSHI YOSHIDA (CSP Japan, Inc., Tokyo) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 13 p. refs

(IAF PAPER 91-650) Copyright

The commercialization of the space industry and programs is discussed with attention given to considering commercialization as an objective vs. as a result. The development of the space industry is reviewed, and commercialization of government space agencies is examined on a per-agency basis. Corrective measures are proposed for problems that affect the successful commercialization of the industry which include: (1) the need for more research funds; (2) the clarification of commercialization's role in science policy; (3) the importance of technological self-sufficiency in spite of external pressure for cooperation; and (4) the need for an increased budget and a committee to promote

commercialization. It is concluded that commercialization should be a means for enhancing the potential and effectiveness of the overall space program. C.C.S.

A92-21495

U.S.-JAPANESE SPACE RELATIONS AT A CROSSROADS

JOHN M. LOGSDON (George Washington University, Washington, DC) Science (ISSN 0036-8075), vol. 255, Jan. 17, 1992, p. 294-300. refs
Copyright

Several scientific, earth-observation, and public service communication missions are currently under discussion between the U.S. and Japan. The many questions that must be addressed for the U.S. to develop a coherent approach to space exploration-related exchanges with Japan, the most fundamental concerns the need to balance U.S. security, political, and technological interests with those of a country whose space-exploration priorities appear to be primarily driven by technological and commercial payoffs. Japan's interests in lunar exploration/exploitation render it a logical candidate for a major cooperative role if a U.S. exploration program is instituted. O.C.

A92-22479

INTERNATIONAL COOPERATION IN LUNAR AND SPACE DEVELOPMENT - JAPAN'S ROLE

CHIKAKO IGUCHI (CSP Japan, Inc., Tokyo) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 12 p. refs

(IAF PAPER 91-709) Copyright

International cooperation in the development of the moon and other celestial bodies is discussed. Particular attention is given to the relationship between humans, the moon, and other celestial bodies; the moon utilization plans in progress as case studies contributing to the understanding of international cooperation; and strategic concepts of international cooperation and Japan's contribution. The latter include the ideas of leadership and partnership for global cooperation and the necessary regulations that meet current international requirements. O.G.

A92-22485* National Aeronautics and Space Administration, Washington, DC.

AN ASSESSMENT OF PROSPECTS FOR INTERNATIONAL COOPERATION ON THE SPACE EXPLORATION INITIATIVE

LYNN F. H. CLINE and JEFFREY D. ROSENDHAL (NASA, Washington, DC) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 10 p. refs

(IAF PAPER 91-707) Copyright

This paper discusses the unique characteristics of the Space Exploration Initiative (SEI) which will have to be taken into account if the Initiative is to become an international one; the technical capabilities offered by prospective international partners; the political and economic prospects for proceeding with the Initiative both in the United States and elsewhere; and the advantages and disadvantages of various possible approaches to international cooperation on SEI. SEI preparatory activities are likely to extend over a several-year period. Such an extended preparatory period should provide the time needed for coordinating studies, for identifying interests and potential contributions, and for resolving the numerous planning, budgeting, organizational and political issues which will have to be dealt with if such a complex undertaking is to be successfully internationalized. Author

A92-23174

POLICY AND LAW IN JAPANESE SPACE COMMERCIALIZATION

KUNIHICO TATSUZAWA (Chuo Gakuin University, Tokyo, Japan) Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 40, Dec. 1991, p. 394-407. refs
Copyright

Japanese space commercialization policy and its legal regime are analyzed. The priority given to technological independence in Japanese space policy and the related problem of openness in the Japanese space market are addressed. The distinction between

the Japanese understanding of the concepts of development and utilization is explained. The international regulation of commercial space activities is reviewed along with its application in Japan. Finally, the Japanese domestic regulation of commercial space activities is described. C.D.

A92-27062#

EMERGING SPACE POLICY ISSUES - AN AIAA VIEW

STANLEY G. ROSEN (AIAA, Washington, DC) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 4 p.

(AIAA PAPER 92-0701) Copyright

As the nation's premier aerospace technical society, the American Institute of Aeronautics and Astronautics (AIAA) continues to be closely involved in the formulation of national aerospace policies. Rapid changes in the global economic and military scene call for reassessment of national objectives and strategies. This paper presents an overview of some of the key current and anticipated space policy issues identified by the Institute, as well as highlights of AIAA positions and activities in these areas. Civil space policy issues include definition of the proper roles and objectives of the federal civil space program, the proper mix of programs to achieve these objectives, and the identification of high-priority initiatives. In general, the Institute supports the recommendations of the 'Augustine Committee', although the paper discusses exceptions to this endorsement. Military space policy issues involve the level of support for space operations in national security activities; the development of new space capabilities, including ballistic missile defense; and the evolution of international space operations for mutual security. Of particular importance are policies which maintain a strong space technology base. Author

A92-35638

AN OUTLINE OF THE SPACE WRECKAGE FROM THE VIEWPOINT OF SPACE LAW

KUNIHICO TETSUZAWA (Chuo University, Tokyo, Japan) IN: Space Station Conference, 7th, Tokyo, Japan, Apr. 16, 17, 1991, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1991, p. 79, 80. In Japanese.

The definitions of space wreckage and space refuse are discussed from the viewpoint of space law. The protection measures against space wreckage are presented, and the international responsibility for space wreckage is addressed. Y.P.Q.

A92-36654

SPACE AND INVENTIONS, THE CONTRACTING ENVIRONMENT

DONALD M. CAMERON (Sim, Hughes, Dimock/Sim & McBurney Barristers and Solicitors/Patent and Trade Mark Agents, Toronto, Canada) IN: Colloquium on the Law of Outer Space, 33rd, Dresden, Federal Republic of Germany, Oct. 6-12, 1990, Proceedings. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 18-22. refs
Copyright

This paper reviews and compares the policies of the Space Station program partners' contracting agencies with regard to ownership of inventions made under procurement contracts. Author

A92-36683

COMMUNITY-INTERESTS OF INTERNATIONAL SOCIETY, ESPECIALLY IN THE FIELD OF SPACE LAW

MEGUMU MAKAMURA (Otaru University of Commerce, Japan) IN: Colloquium on the Law of Outer Space, 33rd, Dresden, Federal Republic of Germany, Oct. 6-12, 1990, Proceedings. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 231-235. refs
Copyright

The concept of community interests is examined to develop a regime for facilitating and governing the exploitation of resources in outer space. References are made to article 18 of the Moon

Agreement and to the community-interests provisions contained in the U.N. Seabed Authority. It is shown that the incompatibility between the community interests of international society and the exclusive interests of the individual state in the realm of space is analogous to that encountered in other areas of international law.

C.C.S.

A92-36684

THE INTERNATIONAL COOPERATION ON THE SPACE STATION

KUNIHICO TATSUZAWA (Chuo Gakuin University, Tokyo, Japan) IN: Colloquium on the Law of Outer Space, 33rd, Dresden, Federal Republic of Germany, Oct. 6-12, 1990, Proceedings. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, p. 250-258. refs

Copyright

The development phase of the international Space Station to be constructed under the cooperation of the U.S.A., Europe, Canada, and Japan, comes into effect after the conclusion of the IGA and MOUs. These two agreements constitute the legal framework of the international cooperation on the Space Station, with the implementing arrangements and the exchanged letters of negotiators. Legal points related to the agreements are discussed including the problem of jurisdiction and control.

Author

A92-51886

THE DEFINITION OF THE SPACE OBJECT

KUNIHICO TATSUZAWA (Chuo Gakuin University, Tokyo, Japan) IN: Colloquium on the Law of Outer Space, 34th, Montreal, Canada, Oct. 5-11, 1991, Proceedings. Washington, American Institute of Aeronautics and Astronautics, 1992, p. 357-362. refs

Copyright

A definition of space object is proposed. The definition of space object in positive law by the ITU, the ELDO, and the UNCOPUOS is reviewed. The applicability of the criteria of flight method, sphere of activities, and nature of activities, and of the factors of nonaeronautical flight and orbital movement, in the doctrinal approach to the definition of space object is discussed.

C.D.

A92-52274

INTERNATIONAL COOPERATION IN LUNAR AND SPACE DEVELOPMENT

CHIKAKO IGUCHI (CSP Japan, Inc., Tokyo) Space Policy (ISSN 0265-9646), vol. 8, no. 3, Aug. 1992, p. 256-268. refs

Copyright

The status of international cooperation in the development of the moon and the nearby planets is discussed focusing on the value of the planets as sources of natural resources which should be regarded as 'common assets of humankind'. Particular attention is given to the national plans of the USA and Japan and the potential for tension between the developed and newly industrializing nations. It is argued that Japan demonstrates its commitment to the interests of the international community by facilitating technology transfer, establishing a space development fund, and setting up an international corporation to back space projects.

O.G.

A92-53778

GROUND RULES FOR SUCCESSFUL INTERNATIONAL SPACE COOPERATION

MASAFUMI MIYAZAWA (NASDA, Propulsion Systems Group, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2309-2311.

Copyright

Space development and its associated activities are inherently international. However, there have been (and still are) many barriers which might undermine the ultimate goal of cooperation. In this paper, key elements leading to successful space cooperation are discussed and reviewed. The major barriers and appropriate measures to overcome them are proposed and analyzed so that all parties will enjoy the benefit of international space cooperation.

Author

A92-53779

SPACE STATION IGA AND DOMESTIC CONTRACTS IN JAPAN

MASAHICO SATO (NASDA, Contract Dept., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2313-2318.

Copyright

NASA Space Station-related activities in Japan concern the Japanese Experimental Module (JEM); the JEM contracts signed with NASDA include contractor adherence to the Space Station's Intergovernmental Agreement (IGA). The IGA establishes a long-term cooperative framework for the Space Station partners. Articles 16 and 19 stipulate a cross-waiver of liability and exchange of data and goods, respectively. JEM contractors will waive all claims based on damage arising from protected space operations against other partners.

O.C.

A92-53780

UNITED NATIONS POLICY TO DEVELOP AN INTERNATIONAL FRAMEWORK GOVERNING THE EXPLOITATION OF NATURAL RESOURCES IN OUTER SPACE

AKIKO FUNAO (Sophia University; Hosei University, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2319-2326. refs

Copyright

U.N. decisionmaking is characterized by procedures aimed at making the voices of small states more nearly equivalent to the voices of large ones. This principle was embodied in the Moon Treaty of 1979. An evaluation is presently made of the significance of this type of network for the prospective exploitation of natural resources in outer space.

O.C.

A92-53781

INTERNATIONAL COOPERATION IN SPACE SCIENCE IN JAPAN AND INTERNATIONAL SPACE YEAR (ISY)

YASUNORI MATOGAWA (Institute of Space and Astronautical Science, Sagami, Japan) IN: International Symposium on Space Technology and Science, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 2327-2330.

Copyright

The historical background of development of international cooperation in space science in Japan is briefly reviewed. Related to such a progress, lessons that have been learned by ISAS will be pointed out. Some problems in Japan are discussed in reflecting the results of space science to teachers who are engaged in actual science education. Such problems will be examined from the standpoint of building up a campaign of the International Space Year in Japan toward 1992, as well as training the younger generation for the future.

Author

A92-55655

JAPANESE SPACE POLICY FOR THE 21ST CENTURY

JOAN JOHNSON-FREESE (Central Florida, University, Orlando, FL) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 31 p. Research supported by MOESC. refs

(IAF PAPER 92-0203) Copyright

The space policy decision-making process in Japan is analyzed in the context of the Japanese culture and traditions. Various aspects of the Japanese system are delineated so that differences from systems of other countries could be distinguished. It is pointed out that prior to initiation of future cooperative endeavors in the space field those differences should be considered to make the cooperation successful.

O.G.

A92-55721

INTERNATIONAL COOPERATION IN FUNDAMENTAL SPACE RESEARCH - PAST EXPERIENCE AND PERSPECTIVES

A. A. GALEEV (Russian Academy of Sciences, Space Research

Institute, Moscow, Russia) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 6 p. refs (IAF PAPER 92-0290) Copyright

The experience of international cooperation in past space projects on solar system exploration (Vega, Phobos, and Roentgen) is evaluated, and the prospects for such cooperation in future space missions such as Mars-94, Mars-96, Spectrum-X, and Interball are discussed. Particular attention is given to the successful international cooperation in the investigations of Comet Halley in March 1986 during the flyby of Vega-1 and Vega-2, Giotto, and Suisei and Sakigake through the cometary coma, as well as the international collaboration in the Phobos experiment. The possible implications of Russian economic difficulties for international space cooperation are addressed. C.A.B.

N92-15934# International Atomic Energy Agency, Vienna (Austria).

AGREEMENT BETWEEN THE INTERNATIONAL ATOMIC ENERGY AGENCY, THE GOVERNMENT OF JAPAN AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA FOR THE APPLICATION OF SAFEGUARDS BY THE AGENCY TO THE BILATERAL AGREEMENT BETWEEN THOSE GOVERNMENTS CONCERNING CIVIL USES OF ATOMIC ENERGY

May 1991 1 p
(DE91-639694; IAEA-INFCIRC-119(MOD-1)) Avail: CASI HC A01/MF A01

The bilateral agreement (set forth in document INFCIRC/119), between the International Atomic Energy Agency, the government of Japan, and the government of the United States of America, for the application of safeguards by the agency to the bilateral agreement between those governments concerning civil uses of atomic energy expired on 17 July 1988, following the termination of the 1968 Agreement for Co-operation. A subsequent Agreement for Co-operation between the two governments concerning peaceful uses of nuclear energy was entered into force on 17 July 1988. Under its provisions agency safeguards are to be applied with respect to past and future peaceful nuclear co-operation between Japan and the USA. DOE

N92-16957# Global Competitiveness Corp., Boston, MA.
SURVEY OF DIRECT US PRIVATE CAPITAL INVESTMENT IN RESEARCH AND DEVELOPMENT FACILITIES IN JAPAN Final Report

JUSTIN L. BLOOM, BRUCE RUBINGER, and CHARLES E. CALDWELL 28 Jan. 1991 117 p Prepared in cooperation with Technology International Corp., Potomac, MD; and National Science Foundation, Washington, DC
(Contract NSF SRS-89-12547)
(NSF-91-312) Avail: CASI HC A06/MF A02

Investment in Japanese R&D facilities by U.S. firms has increased with Japan's emergence as a leading source of technology and as a major market. Such facilities allow U.S. industry to tap Japan's technology base, improve market access with products geared to the Japanese and Asian markets, and to respond quickly to customer needs. This trend represents a critical strategic shift with important implications for U.S. technological competitiveness. A comprehensive survey was performed that covered all areas of research and all industrial sectors. More than 275 firms were contacted that were previously identified by various sources as having research facilities in Japan. The study found that there are approximately 71 U.S. organizations with R&D operations in Japan, either in the form of wholly owned subsidiaries or of joint ventures with Japanese corporations. Author

N92-17283# National Academy of Sciences - National Research Council, Washington, DC. Office of Japan Affairs.
SCIENTIFIC AND TECHNOLOGICAL RELATIONS BETWEEN THE UNITED STATES AND JAPAN: ISSUES AND RECOMMENDATIONS

FRANK PRESS and MARTHA C. HARRIS Nov. 1990 39 p
Sponsored by Commission on United States-Japan relations for

the Twenty First Century

(PB91-219170) Avail: CASI HC A03/MF A01

Discussed here are issues and recommendations relating to Japanese investment in small, high technology corporations, treatment of multinational companies, foreign funding for U.S. university research, asymmetry in training, U.S.-Japan cooperation in science and technology, and asymmetries in science and technology. Author

N92-20389# Commission on US-Japan Relations for the Twenty First Century, Washington, DC.

COMMISSION ON US-JAPAN RELATIONS FOR THE 21ST CENTURY: AMERICA'S STAKE IN THE FUTURE OF THE US-JAPAN RELATIONSHIP-ISSUES AND RECOMMENDATIONS Final Report

1991 34 p Sponsored in part by Ford Foundation, New York; and Rockefeller Bros. Fund, New York
(PB92-114149) Copyright Avail: CASI HC A03/MF A01

America's relationship with Japan is coming to the end of an era. That era was one of progress and growing interdependence but it was also characterized by rising tension over the way the two countries manage their economies. In the past, a common overriding interest in containing the threat from the Soviet Union sheltered U.S.-Japan ties from the effects of trade and other economic frictions. In the post-Cold War period, however, a new basis for the relationship between the U.S. and Japan will have to be established or economic conflict could bring the alliance to an end. Recommendations are made which are intended to help shape the development of a new U.S.-Japan relationship for the coming century. Author

N92-20700# Commission on US-Japan Relations for the Twenty First Century, Washington, DC.

PREPARING FOR A PACIFIC CENTURY: EXPLORING THE POTENTIAL FOR PACIFIC BASIN COOPERATION. PERSPECTIVES FROM AN INTERNATIONAL CONFERENCE

G. W. SHINODA and F. J. MCNEIL 1991 170 p Conference held in Washington, DC, 16-17 Jul. 1991
(PB92-114156) Avail: CASI HC A08/MF A02

A collection of papers is presented on the following topics: exploring the U.S.-Japan relationship in a pacific context; can the pacific save the U.S.-Japan economic relationship; the pacific's role in moderating U.S.-Japan economic conflicts; business independence and intrafirm trade in the pacific area; can the U.S. and Japan save the pacific; perspectives from the pacific rim; in search of post-containment stability in the pacific; pacific basin trade and its implications; pacific development; the environment and prosperity. GRA

N92-33798# CSP Japan, Inc., Tokyo.

INTERNATIONAL COOPERATION AND JAPAN'S ROLE IN LUNAR AND PLANET EXPLOITATION [TSUKI, WAKUSEI KAIHATSU NI OKERU KOKUSAI KYOURYOKU TO NIHON NO YAKUWARI]

TOMOKO IGUCHI /in NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 19 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

The necessity, present status, and future possibility of international cooperation and Japan's role in space development activities on the moon and other celestial bodies within the solar system are studied. The results of the study on the definition of the moon and other celestial bodies and the value of their resources are outlined. It is pointed out that the way of exploration activities on those celestial bodies largely depends on their resources. Lunar utilization projects in the U.S. and Japan are outlined. In the U.S., usefulness of the lunar utilization is divided as a celestial body land and as resources. The former is the lunar exploration as the first step of other celestial body utilization and the latter is the utilization for space colony, solar power system, and helium-3 resource. The way of international cooperation in the exploration activities and necessity of legislative system are discussed. Technology transfer measures, and establishment of a development

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

fund and an international consortium are presented as a guideline for development of a system and international cooperation.

Author (NASDA)

N92-33799# Shimizu Corp. (Japan). Space Project Office. ESTABLISHMENT OF LEGISLATIVE SYSTEM FOR SPACE COMMERCIALIZATION [UCHUU SHOUGYOU KA NI OKERU HOU SEIDO NO SEIBI]

KAZUYA FUSHIMI / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 9 p 17 Jul. 1991 In JAPANESE Avail: CASI HC A02/MF A10

The way to realize the commercial use of space environments is studied from perspectives of practical business area after conducting discovery and analysis of problems recognizing that space activities are born under industrial structures of a capitalism economy and power structure generated in the political background. The results of the study on human activities and the necessity of their order, evaluation of space development and related problems, and establishment of legislative system for commercial use of space environment are outlined.

Author (NASDA)

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URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

A92-43241

WIG TRANSPORTATION EFFICIENCY CONSIDERING THE INFLUENCE OF NO-LOAD SITUATION

S. ANDO (Nagoya University, Japan) IN: Aircraft Symposium, 28th, Tokyo, Japan, Nov. 7-9, 1990, Proceedings. Tokyo, Japan Society for Aeronautical and Space Sciences, 1990, p. 628-631. In Japanese. refs

The configurations and endurance of PAR-WIG aircraft are presented. The no-load situation and structural weight of the airframe are analyzed. The transportation efficiency of the WIG is evaluated.

Y.P.Q.

N92-25500# Westover Consultants, Inc., Washington, DC.

SUMMARY OF PROCEEDINGS, NATIONAL SCIENCE FOUNDATION: JAPANESE TECHNOLOGY EVALUATION CENTER WORKSHOP

1991 62 p Workshop held in Washington, DC, 13 May 1991 Sponsored in part by NSF

(PB92-100643) Avail: CASI HC A04/MF A01

An overview is given of the Japanese Technology Evaluation Center (JTEC) program. Topics covered include the U.S. - Japan science and technology agreement, technology transfer, National Science Foundation international activities, the U.S. - Japan Industry and Technology Management Training Program, Department of Defense needs for technology assessments, JTEC information dissemination, and a discussion of future directions.

Author

88

SPACE SCIENCES (GENERAL)

A92-26686

A NEW-TYPE ANTENNA FOR CONTINUOUS GRAVITATIONAL RADIATION

T. SUZUKI (National Laboratory for High Energy Physics, Tsukuba; Tokyo, University, Japan), N. AKASAKA (Tokyo, University, Japan),

Y. OGAWA, N. KUDO, and K. MORIMOTO (National Laboratory for High Energy Physics, Tsukuba, Japan) Review of Scientific Instruments (ISSN 0034-6748), vol. 63, March 1992, p. 1880-1883. refs

Copyright

A new-type disk antenna has been developed to search for continuous gravitational waves emitted from millisecond and submillisecond pulsars. The antenna not only has a wide tunable range of the eigenfrequency that covers down to almost half of the original frequency of the quadrupole mode, but also is easily tuned to an objective frequency with an accuracy of 4×10^{-5} at 4.2 K. The mechanical quality factor has reached 3.0×10^7 at 4.2 K in an antenna made of A15056.

Author

A92-57348

SETI IN JAPAN

HISASHI HIRABAYASHI (Institute of Space and Astronautical Science, Sagami, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 3 p. refs (IAF PAPER 92-1025) Copyright

Three kinds of methodology for SETI that have been proposed or tried in Japan are presented. A formaldehyde line absorption channel towards dark clouds, microwave activity, and the detection of artificial information on phage Phi-X174 DNA are addressed.

P.D.

89

ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy; and astrometry.

A92-12214

A SEARCH FOR GALAXIES BEHIND THE MILKY WAY BETWEEN $l = 230$ AND 250 DEG

MAMORU SAITO, HIROSHI OHTANI, AYUMI BABA, HIDEAKI HOTTA, SEIJI KAMENO, SADA O KUROSU, KENICHI NAKADA, and TADAFUMI TAKATA (Kyoto University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 449-468. refs

Copyright

A systematic search for galaxies behind Milky Way is carried out by means of film copies at an effective wavelength of 790 nm. Visual inspection was made of 14 films; a total of 4633 galaxies were detected with diameters greater than 0.1 arcmin. The detected galaxies were cataloged with regard to position, size, galaxy type, and cross identification. More galaxies were detected at regions with less H I column densities in the Milky Way; the characteristics of the Galactic extinction are similar to those found in the first investigation between l of 210 and 230 deg. A superposition of some clusters of galaxies is seen around l of 240 deg, and b of 4 deg over about 15 deg in angular size; the clusters are distributed from 50 to 350 Mpc. A nearby cluster of galaxies is also at a distance of about 35 Mpc around l of 243 deg and b of -6 deg, with an elongated structure nearly vertically against the Galactic plane linking the Antlia cluster to the Lepus cloud.

C.A.B.

A92-13029

A SECONDARY WOBBLING MECHANISM FOR A BALLOON-BORNE INFRARED TELESCOPE

HIDEO MATSUHARA (Nagoya University, Japan), NORIHISA HIROMOTO (Communications Research Laboratory, Koganei, Japan), HIROSHI SHIBAI, TAKAO NAKAGAWA, HARUYUKI OKUDA (Institute of Space and Astronautical Science, Sagami, Japan), and TOSHINORI MAIHARA (Kyoto University, Japan) Review of Scientific Instruments (ISSN 0034-6748), vol. 62, Nov. 1991, p. 2535-2539. Research supported by Japan Society for the Promotion of Science and MOESC. refs

(Contract NSF INT-86-13481)

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A wobbling mechanism for a secondary mirror has been developed for a balloon-borne infrared telescope. Friction of the wobbling mechanism is negligibly small, and hence the wobbling mechanism is very reliable for the use in a severe environment at balloon altitudes. Motion is controlled by servo electronics, whose transfer function includes the second-order differential term of the error signal in order to improve the waveform. Good performance of the drive mechanism has been confirmed in two balloon flights in 1988 at an altitude of 31 km. Author

A92-17085

THE JAPANESE NATIONAL LARGE TELESCOPE

TOMAKAZU KOGURE (Kyoto University, Japan) and KEIICHI KODAIRA (National Astronomical Observatory, Mitaka, Japan) (IAU, Asian-Pacific Regional Astronomy Meeting, 5th, Sydney, Australia, July 16-20, 1990, Proceedings. A92-17077 04-90) Astronomical Society of Australia, Proceedings (ISSN 0066-9997), vol. 9, no. 1, 1991, p. 52-54.

The 8-m optical-IR reflector is described in terms of the conceptual design, the telescope's site and dome, instrumentation, and the prospects for investigation with international cooperation. The primary mirror is 1/2 and designed for fabrication from monolithic thin meniscus, and special ancillary features are described including fast optics, a thermally controlled dome, and active mirror support. Particular attention is given to the motivation and strategies for optimizing the quality of the instrument in terms of IR study. Construction of the instrument is expected to be complete around 1998, and international collaboration on the fabrication and use of the facility is expected. C.C.S.

A92-17086

SPACE ASTROPHYSICS IN JAPAN

KAZUO MAKISHIMA (Tokyo, University, Japan) (IAU, Asian-Pacific Regional Astronomy Meeting, 5th, Sydney, Australia, July 16-20, 1990, Proceedings. A92-17077 04-90) Astronomical Society of Australia, Proceedings (ISSN 0066-9997), vol. 9, no. 1, 1991, p. 57-59. refs

The overview of Japanese space programs describes long-term strategies and missions dedicated to the study of solar physics, cosmic X-ray astronomy, IR astronomy, or radio astronomy. Collaboration with the U.S. is noted for the shuttle-assisted Infrared Telescope in Space which requires a small unmanned space platform. Five satellite projects under development are mentioned, four of which are dedicated exclusively to astronomical observations, and the basic parameters are given of astronomical satellites already launched. C.C.S.

A92-17477

AN IMAGE PROCESSING TECHNIQUE FOR BACKGROUND SUBTRACTION AND ITS APPLICATION TO COMET AUSTIN 1989C1

HIDEO FUKUSHIMA and JUN-ICHI WATANABE Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 185-189. refs

This study presents an image-processing method for background subtraction for investigating the large-scale structure of cometary trails. The principle behind this method is that the final image-containing information on the comet is made by subtracting the image of background objects which is taken at a different epoch. The details of this method together with an example of its application to Comet Austin 1989c1 are presented. P.D.

A92-17478

NEAR-NUCLEUS IMAGING OBSERVATION OF COMET P/BROSEN-METCALF 1989O

JUN-ICHI WATANABE and TSUKO NAKAMURA Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 191-201. refs

Results of observations of periodic Comet Brosen-Metcalf 1989 are presented. Twenty-two near-nucleus CCD images were obtained on August 3-4, 1989. A broad jet in images for C2

molecules was found. The time variation of tail rays was also observed in images for H₂O(+) ions. Data tables, contour maps of seven representative CCD images, and some results of image processing that show this planet's near-nucleus morphology are presented. P.D.

A92-17479

A SEARCH FOR COOL CARBON STARS. V - PERSEUS-CAMELOPARDALIS (L ABOUT 150 DEG) REGION

TAKAO SOYANO (Kiso Observatory, Tokyo, Japan) and HIDEO MAEHARA Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 203-223. refs

A search for cool carbon stars has been consecutively made using the 4-deg prism spectra of the Kiso 105-cm Schmidt telescope. The surveyed area in this paper is the 235-square-degree area in the Perseus-Camelopardalis region (l = 132 to 158 deg, b = -8 to 7 deg). The celestial position, V magnitude, is presented, and the finding chart of 226 cool carbon stars derived from V-band plates. Many stars in this list are identified with carbon stars in Stephenson's (1989) general catalog, and with sources in the IRAS catalog. The distribution and the variability of cool carbon stars are briefly discussed. Author

A92-17480

SELECTION OF STANDARD STARS FOR PHOTOMETRIC OBSERVATIONS WITH THE 91-CM REFLECTOR AT OKAYAMA

MASAYUKI KONDO (Tokyo, University, Japan), ETSUJI WATANABE, and MASAMI YUTANI Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 225-238.

A92-17481

KISO SURVEY FOR ULTRAVIOLET-EXCESS GALAXIES

BUNSHIRO TAKASE (Kokugakuin University, Tokyo, Japan) and NAGAKO MIYAUCHI-ISOBÉ Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 239-265.

The 14th list and identification charts of the UV-excess galaxies detected on the multicolor plates taken with the Kiso Schmidt telescope for 10 survey fields are presented. In the sky area of some 300 sq deg, about 470 objects are cataloged down to the photographic magnitude of about 17.5. P.D.

A92-17482

NEAR-NUCLEUS IMAGING OBSERVATIONS OF COMET AUSTIN 1989C1

JUN-ICHI WATANABE, SHIN-ICHI ICHIKAWA (National Astronomical Observatory, Mitaka, Japan), KUNIO TAKAGISHI, ISAMU HATSUKADE (Miyazaki University, Japan), MINORU SASAKI (Shimonoseki City University, Japan), TORU YAMADA (Kyoto, University, Japan), HAJIME SUGAI, EIJI NISHIHARA, KAZUHIRO SHIMASAKU (Tokyo, University, Japan), YOSHIKI TANIGUCHI (Tohoku University, Sendai, Japan) et al. Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 267-291. refs

Imaging observations of Comet Austin 1989c1 were carried out with optical CCD imaging systems. Three telescopes were used to monitor the time variation of the near-nucleus region. Fifty-three images were obtained during the period between April 24 and May 15. While the images in the Johnson B and R bands show prominent ion tail structure, those in the standard IHW continuum band show a round coma. No distinctive jet feature is recognized during the present monitoring period. This paper presents reproductions of 18 representative images together with the isophotal maps in relative intensity unit. Author

A92-17483

COSMO-DICE - DYNAMICAL INVESTIGATION OF COMETARY EVOLUTION

TSUKO NAKAMURA and MAKOTO YOSHIKAWA Japan, National

Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 293-383. refs

The numerical integration of the orbital evolution of about 160 periodic comets for 3400 yr and 1000 yr toward the past and the future, respectively, is calculated. Planetary positions taken from the JPL planetary ephemeris DE102 are incorporated in integration. The accuracy of each orbital evolution is estimated by the round-trip error in a closure test, and a measure of the reliable time span for each calculated orbit is given. The time history of Kepler elements, perihelion distance, and Tisserand's invariant is shown graphically for each comet. It is found that the majority of the comets with their Tisserand constants between 2.8 and 3.1 evolve within 1000-2000 yr from the orbits whose perihelia are near the Jovian orbit to the orbits with perihelia of 1-2 AU. All the calculations are compiled on a magnetic tape of about 100 MB in a FITS format, which contains the position and velocity vectors of each comet in a 64-day interval for 4400 yr. P.D.

A92-24304

OBSERVATIONS OF DIFFUSE INFRARED RADIATION BY A SMALL CRYOGENICAL TELESCOPE, IRTS

HARUYUKI OKUDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: The galactic and extragalactic background radiation. Dordrecht, Netherlands, Kluwer Academic Publishers, 1990, p. 435-439. refs
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A small, cryogenically cooled infrared telescope named IRTS (Infrared Telescope in Space) is under development. The telescope is equipped with spectrometers and a photometer with medium spatial and spectral resolution covering the wavelength range from 1 to 1000 microns. The instrument is specially designed for observations of the cosmic background radiation and galactic infrared radiation. It will be flown on board a Japanese reusable free-flyer called SFU (space flyer unit) to be launched in 1994.

Author

A92-27439

GINGA OBSERVATIONS OF THE OLD NOVA GK PERSEI IN QUIESCENCE AND OUTBURST

M. ISHIDA, T. SAKAO, K. MAKISHIMA, T. OHASHI (Tokyo, University, Japan), M. G. WATSON (Leicester, University, England), A. J. NORTON (Southampton, University, England), M. KAWADA, and K. KOYAMA (Nagoya University, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 254, Feb. 15, 1992, p. 647-654. refs
Copyright

Ginga observations of the old nova GK Persei in quiescence, as well as a brief scanning observation during an outburst are reported. The X-ray spectrum in quiescence is well fitted by thermal bremsstrahlung emission of very high temperature (approximately 30 keV), plus an iron emission line. The outburst spectrum is complex and comprises two continua with different column densities (about 10^{23} and about 10^{24} cm⁻²). The 351-s spin modulation of GK Per was clearly detected in the quiescence observation, which confirms the results of previous Exosat observations. The folded light curve shows two peaks that are not separated by 180 deg in phase, which is quite different from the Exosat outburst data. It is similar to the Exosat observation at a similar flux level. P.D.

A92-39756

ROCKET OBSERVATION OF THE NEAR-INFRARED SPECTRUM OF THE SKY

M. NODA, V. V. CHRISTOV, H. MATSUHARA, T. MATSUMOTO, S. MATSUURA, K. NOGUCHI, S. SATO (Nagoya University, Japan), and H. MURAKAMI (Institute of Space and Astronautical Science, Sagami-hara, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 391, no. 2, June 1, 1992, p. 456-465. Research supported by Inoue Foundation for Science and Kajima Foundation. refs
(Contract MOESC-02952011; MOESC-63840003)
Copyright

The near-infrared spectrum of the diffuse emission was

observed using a rocket-borne infrared telescope cooled by liquid helium with a newly developed charge integrating detection system. The observed sky brightness at high ecliptic and Galactic latitude is consistent with the previous result obtained by Matsumoto, Akiba, and Maurakami, and also with the early report from the Cosmic Background Explorer (COBE). The spectrum is generally smooth. The observed sky brightness seems to be dominated by zodiacal light, and the contribution of star light is negligible. The near-infrared spectrum of the derived zodiacal light is similar to the solar color. The total brightness, however, is significantly brighter than that expected from previous optical measurements of the zodiacal light. A possible interpretation of the observed spectrum is discussed. Author

A92-46703

ASTROMETRIC OBSERVATIONS OF ASTEROID HIDALGO NEAR ITS PERIHELION

TSUKO NAKAMURA, GORO SASAKI (National Astronomical Observatory, Mitaka, Japan), SADANORI OKAMURA (Tokyo, University, Japan), MASARU HAMABE, SHIGEOMI YOSHIDA (Kiso Observatory, Nagano, Japan), and YOSHIKI TANIGUCHI (Tohoku University, Sendai, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. L19-L21. refs
Copyright

The astrometric positions of asteroid Hidalgo have been obtained for the period October 1990 through March 1991, including positions near its perihelion passage in 1991. The results should help clear up whether Hidalgo is an asteroid or actually a comet. C.D.

A92-48277

KISO SURVEY FOR ULTRAVIOLET-EXCESS GALAXIES. XV

BUNSHIRO TAKASE (Kokugakuin University, Tokyo, Japan) and NAGAKO MIYAUCHI-ISOBÉ Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 3, 1992, p. 399-429. refs

The fifteenth list and identification charts of the ultraviolet-excess galaxies are presented. These galaxies were detected on the multicolor plates taken with the Kiso Schmidt telescope for 10 survey fields. In the sky area of 300 square degrees 544 objects are cataloged down to the photographic magnitude of about 17.5. O.G.

A92-48278

SPECTRAL INDEXES OF COOL CARBON STARS IN THE NEAR-INFRARED REGION. II

WATARU TANAKA (Tokyo, University, Japan), OSAMU HASHIMOTO (Seikei University, Musashino, Japan), TOSHIHIKO TANABE (Tokyo, University, Mitaka, Japan), ISSEI YAMAMURA (Tokyo, University, Japan), TAKAFUMI OKADA, and YASUMASA YAMASHITA Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 3, 1992, p. 431-457. refs

Following the previous paper (Tanaka et al., 1990, hereafter as Paper I), near-infrared spectroscopic observations of cool carbon stars have been continued with the Fourier transform spectrometer and the 188 cm reflector at Okayama Astrophysical Observatory. Sixty-six spectra of 63 carbon stars were analyzed. Eighteen stars were newly added to the program stars, and the total number of the analyzed carbon stars reached 101. Three spectral indexes defined in Paper I; the color index, the CO-index, and the C2-index were measured. The same analysis was made independently as before, because the spectra were taken at different phases of their variabilities and their signal-to-noise ratios were much improved by careful observations. General trends of the results obtained in Paper I are confirmed. Author

A92-48279

SPECKLE OBSERVATIONS OF VISUAL AND SPECTROSCOPIC BINARIES. III

SYUZO ISOBÉ, MOTOKAZU NOGUCHI, JUNJI OHTSUBO (Shizuoka University, Hamamatsu, Japan), NAOSHI BABA,

NORIAKI MIURA (Hokkaido University, Sapporo, Japan), TAKASHI TANAKA, and MIKINORI NI-INO (Chuo University, Tokyo, Japan) Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 3, 1992, p. 459-474. refs

This is the third paper of this series giving results of speckle observations carried out for seven visual and 119 spectroscopic binaries at seven nights from May 20 to May 27, 1989, and for 30 visual and 272 spectroscopic binaries at 12 nights from June 11 to June 15, and from August 28 to September 3, 1990, using the 212-cm telescope at San Pedro Martir Observatory in Mexico. Fringes in the lower spectrum of 31 visual and spectroscopic binaries with angular separation larger than 21 arcsec are obtained. Additionally to two spectroscopic binaries, HD41116 and HD206901, named in the second paper of this series, six spectroscopic binaries are found each of which has the third component star surrounding two stars of spectroscopic binary having periodic variation of radial velocity. Author

A92-48280

THE TOKYO PMC CATALOG 88 - CATALOG OF POSITIONS OF 3800 STARS OBSERVED IN 1988 AND PLANETARY POSITIONS OBSERVED IN 1988 TO 1988 WITH TOKYO PHOTOELECTRIC MERIDIAN CIRCLE

MASANORI YOSHIZAWA, SHUNSAKU SUZUKI, and MITSURU SOMA Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 3, 1992, p. 475-546. refs

The fourth annual catalog of the Tokyo PMC is presented for 3800 stars (Part I and Part II) which had been observed at least two times in the 1988 period, that is, from January 1, 1988, to December 31, 1988. The positions of the stars given in the catalog are those at the mean epoch of observations. The coordinates of the catalog are based on the FK5 system, and are referred to the equinox and equator of J2000.0. The positions of five major and nine minor planets are also given in the present catalog (Part III) for all individual observations made in 1986 to 1988. The planetary positions are based on the same coordinate systems as those of the corresponding annual star catalogs, the Tokyo PMC Catalogs 86, 87, and 88. The mean trends of the observed positions - FK5 positions for the basic FK5 stars are constructed and compared with those of the Tokyo PMC Catalogs 86 and 87. As for the planets, their observed positions are compared with the positions of the JPL's planetary ephemeris DE200. It is found that the ephemerides of the outermost planets, Uranus and Neptune, have some systematic deviations of a few tenths of arcsec in longitudes. Author

A92-48281

PERFORMANCE OF SUBARU TELESCOPE IN 0.3-30 MICRON

SAEKO S. HAYASHI, SADANORI OKAMURA (Tokyo, University, Japan), and HIROSHI SHIBAI (Institute of Space and Astronautical Science, Sagami-hara, Japan) Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 3, 1992, p. 547-550. refs

One of the remarkable features of SUBARU telescope, a Japanese National Large Telescope of 8.2 m diameter, to be put on Mauna Kea, Hawaii, is its wide coverage over a spectral range of 0.3 to 30 microns, from near-ultraviolet to the middle infrared wavelengths. Sensitivity of the observations with this telescope is examined and compared with virtual telescopes with different structure and located in different environments. As expected, SUBARU is characterized by high sensitivity in the high dispersion spectroscopy mode. The performance in optical-near infrared regime is approaching the optimum of the detecting technology. It is important for the telescope design to suppress the thermal background for the observations at middle infrared wavelengths. Author

A92-54579

FIRST FRINGE WITH THE WASEDA FFT RADIO TELESCOPE JUNICHI NAKAJIMA, EIICHIRO OTOBE, KAZUHIKO NISHIBORU, NAOKI WATANABE (Waseda University, Tokyo, Japan), KUNIYUKI ASUMA (Souka High School, Japan), and TSUNEAKI DAISHIDO (Waseda University, Tokyo, Japan) Astronomical Society of Japan,

Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. L35-L38. Research supported by Toray Science Foundation and Waseda University. refs

(Contract MOESC-01400006)

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A sixty-four-element FFT type radio interferometer has been constructed at Waseda University. Using 2 elements, fringe observations of radio sources were started. During observations of 1991 November 10-20, the fringes of Cas A and Tau A were detected. The performance of the radio telescope, which includes backend digital processors, have been confirmed by switching observations. Each element is a 2.4-m diameter Cassegrain antenna with a receiver of 200 K noise temperature. The purpose of the telescope is to survey transient radio sources. Author

A92-56390

DIRECT IMAGING DIGITAL LENS FOR TRANSIENT RADIO SOURCE SURVEY

TSUNEAKI DAISHIDO (Waseda University, Tokyo, Japan), KUNIYUKI ASUMA (Soka High School, Japan), KAZUHIKO NISHIBORI (Sony Corp., Atsugi, Japan), JUNICHI NAKAJIMA, MOTOKO YANO, EIICHIRO OTOBE, NAOKI WATANABE, AKIRA TSUCHIYA (Waseda University, Tokyo, Japan), and SEIICHIRO IWASE (Sony Corp., Tokyo, Japan) IN: Radio interferometry: Theory, techniques, and applications; Proceedings of the 131st IAU Colloquium, Socorro, NM, Oct. 8-12, 1990. San Francisco, CA, Astronomical Society of the Pacific, 1991, p. 86-89. refs

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An FFT-based direct imaging digital lens for transient radio source surveying is discussed and compared with Fourier synthesis. The use of the lens for precise manipulation of the radiation field is described. C.D.

A92-56496

SPECKLE OBSERVATIONS OF SPECTROSCOPIC BINARIES

SYUZO ISOBE (National Astronomical Observatory, Mitaka, Japan) (IAU, Asian-Pacific Regional Astronomy Meeting, 5th, Sydney, Australia, July 16-20, 1990, Proceedings. A92-56476 24-90) Astronomical Society of Australia, Proceedings (ISSN 0066-9997), vol. 9, no. 2, 1991, p. 270-272. refs

Results from speckle observations of binary stars carried out between 1987 and 1990 using a 212-cm telescope at the San Pedro Martir Observatory, Mexico, are presented. Fringe patterns for 21 of the 76 reduced spectroscopic binaries in the Fourier domain were detected. The speckle observations and the astrometric observations are consistent for the stars HD41116, HD202275, and HD206901. C.A.B.

N92-25791# Helsinki Univ. of Technology, Espoo (Finland). Metsaehovin Radiotutkimuskeskus.

FINNISH PARTICIPATION IN THE RADIOASTRON PROGRAM [SUOMEN OSALLISTUMINEN RADIOASTRON-OHJELMAAN]

ESKO VALTAOJA (Turku Univ., Finland) In Oulu Univ., Second Meeting of Finnish Space Researchers p 73-74 1990 In FINNISH

Avail: CASI HC A01/MF A01

Finland is taking part, with ten other countries, in the Soviet Radioastron 1 program. Radioastron 1 is to be launched in 1994. Finland will help construct part of the equipment and will provide ground based support. Finland is a member of the management of Radioastron (RISC) and its Scientific Objectives Committee. A newly proposed study is participation in the VLBI (Very Long Base Interferometry) satellite (IVS/International VLBI Satellite). A study to evaluate the feasibility of Finnish participation in the Japanese VSOP project (the Japanese equivalent of VLBI) is discussed. ESA

N92-34195*# American Astronomical Society, Washington, DC. THE 30TH AAS GODDARD MEMORIAL SYMPOSIUM. WORLD SPACE PROGRAMS AND FISCAL REALITY: SYNOPSIS

1992 33 p Presented in Alexandria, VA, 9-10 Apr. 1992 (NASA-TM-107971; NAS 1.15:107971) Avail: CASI HC A03/MF A01

90 ASTROPHYSICS

A full proceedings of the symposium will be issued later in the year. This synopsis consists of summations of three sessions by appointed rapporteurs. International figures in space and in politics spoke at the sessions. Themes of international cooperation and fiscal reality pervaded the conference. International speakers from Canada, the European Space Agency, Russia, Japan and China and other countries addressed the topic of the symposium. American representation included Senator Barbara Mikulski, former NASA administrator James Beggs and other speakers. R.L.B.

90

ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

A92-10002* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE FUTURE OF COMETARY PLASMA RESEARCH

MARCIA NEUGEBAUER (JPL, Pasadena, CA) IN: Cometary plasma processes. Washington, DC, American Geophysical Union, 1991, p. 1-4. refs

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Advances in the acquisition and analysis of cometary data are reviewed with attention given to current research and projects under development. The need for supplementing the present cometary data is underscored by discussing observational missions from the ground and earth orbit such as the Giotto Extended Mission and the Comet Rendezvous Asteroid Flyby. The interpretation of Comet Halley data is characterized as advanced with respect to both complete observational data and sophisticated modeling. C.C.S.

A92-10026

ACCELERATION MECHANISMS FOR COMETARY IONS

T. TERASAWA (Kyoto University, Japan) IN: Cometary plasma processes. Washington, DC, American Geophysical Union, 1991, p. 277-286. refs

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In situ observation showed that efficient particle acceleration occurs in the region around comets. Emphasis has been placed on the second-order Fermi acceleration process, by which cometary ions can be efficiently accelerated provided that the hydromagnetic turbulence around comets consists of waves of different phase velocities. In the light of accumulated information on the cometary environment, several acceleration models shall be reevaluated.

Author

A92-10505

THREE-MODE CEPHEID PULSATION. II - AN EXAMPLE OF THE THREE-MODE INTERACTING HYDRODYNAMIC MODEL OF CLASSICAL CEPHEID

T. ISHIDA and M. SAITOU (Tohoku University, Sendai, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 182, no. 1, Aug. 1991, p. 69-74. refs

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A92-10506

THE ULTRAVIOLET EXTINCTION BY HOLLOW SPHERICAL PARTICLES OF GRAPHITE

T. INAGAKI, Y. YAMAMOTO, and S. YABUSHITA (Osaka Kyoiku University, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 182, no. 1, Aug. 1991, p. 75-80. refs

Copyright

The discrete dipole approximation has been used to calculate the extinction efficiency of hollow spherical particles of graphite as a possible constituent of interstellar grains. The particles had a shell structure with the basal plane perpendicular to the radius. The calculations were made on particles with an outer radius of

10 and 5 nm in the wave number region from 0.8 to 8.0 micron using the anisotropic optical constants. It is found that hollow particles with an inner radius equal to 0.65 of the outer radius yield an extinction feature at 4.6 micron, which fits fairly well to one observed in the interstellar extinction. Author

A92-10581

FLARE EVENT STATISTICS ON UV CETI-TYPE STARS

K. ISHIDA (Tokyo, University, Mitaka, Japan), K. ICHIMURA (National Astronomical Observatory, Mitaka, Japan), Y. SHIMIZU (Okayama Astrophysical Observatory, Japan), and MAHASENAPUTRA (Bosscha Observatory, Lembang, Indonesia) Astrophysics and Space Science (ISSN 0004-640X), vol. 182, no. 2, Aug. 1991, p. 227-240. refs

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A statistical study of 228 flares on three UV Ceti-type stars, YZ CMi, AD Leo, and EV Lac, is presented. The study is based on observations made over a total monitoring time of 907 hr distributed over 18 years (1971-1988). Cumulative number distributions of flare event time-integrated energies are solved by a least-squares method on log-log plot for a power-law function to obtain both the constant alpha and the gradient beta, which are found to be similar among the three stars. The gradient showed that rare large flare events radiate most of the energy released by all the flare events in the monitoring time. The flare number rate and energy are found to be similar if the power-law distributions are extended up to a specific maximum energy. O.G.

A92-10592

THE LUMINOSITY FUNCTION FOR THE GLOBULAR CLUSTER M15

MAHIRO SIMODA, KOZUE NAKAJIMA (Tokyo Gakugei University, Koganei, Japan), and TAKASHI FUKUOKA (Matsudo High School, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 183, no. 1, Sept. 1991, p. 51-65. refs

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The luminosity function is derived experimentally with observations from a 4-m reflector and compared to theoretical values proposed by Simoda and Iben (1970) and by others. The star counts to the cluster center and to the tidal limit are derived for the measured region (2.5-8.0 arcmin) by using photometric results and counts from other authors. The observed luminosity function for M15 is consistent with the theoretical prediction for X of approximately 0.9 ± 0.1 . The value is found to be acceptably consistent with the Big Bang cosmology value of $X = 0.76$ and inconsistent with the theoretical results by Bertelli et al. (1979). Three candidate reasons for the discrepancy are set forth: (1) inaccuracies of published theoretical luminosity functions; (2) erroneous extrapolations of star counts; and/or (3) erroneous evolutionary theory for Population-II stars. C.C.S.

A92-11649

A STUDY OF THE SPATIALLY-RESOLVED T TAURI SYSTEM

TOSHINORI MAIHARA and HIROKAZU KATAZA (Kyoto University, Japan) Astronomy and Astrophysics (ISSN 0004-6361), vol. 249, no. 2, Sept. 1991, p. 392-396. refs

(Contract MOESC-61420003; MOESC-62041058)

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High precision visibility curves for the T Tau system have been obtained in the K-band by speckle interferometric observations using a 32-element linear array detector. It is confirmed that the T Tau system consists of three infrared sources, which are a central optical/infrared star: T Tau (O), an infrared object: T Tau (S) at 0.6 arcsec south, and a faint stellar object: Tau (O-prime) at 0.4 arcsec north. Based on the present observations, as well as on published photometric data, decomposed spectral energy distributions of the individual sources are proposed. A predominant role for accretion disk luminosities is suggested. Author

A92-12089* Kyoto Univ. (Japan).

GRAVITATIONAL LENSING FREQUENCIES - GALAXY CROSS-SECTIONS AND SELECTION EFFECTS

MASATAKA FUKUGITA (Kyoto University, Japan) and EDWIN L. TURNER (Princeton University Observatory, NJ; National Astronomical Observatory, Mitaka, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 253, Nov. 1, 1991, p. 99-106. refs

(Contract NAGW-2448; NAGW-2173)

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Four issues - (1) the best currently available data on the galaxy velocity-dispersion distribution, (2) the effects of finite core radii potential ellipticity on lensing cross sections, (3) the predicted distribution of lens image separations compared to observational angular resolutions, and (4) the preferential inclusion of lens systems in flux limited samples - are considered in order to facilitate more realistic predictions of multiple image galaxy-quasar lensing frequencies. It is found that (1) the SIS lensing parameter F equals 0.047 ± 0.019 with almost 90 percent contributed by E and S0 galaxies, (2) observed E and S0 core radii are remarkably small, yielding a factor of less than about 2 reduction in total lensing cross sections, (3) 50 percent of galaxy-quasar lenses have image separations greater than about 1.3 arcsec, and (4) amplification bias factors are large and must be carefully taken into account. It is concluded that flat universe models excessively dominated by the cosmological constant are not favored by the small observed galaxy-quasar lensing rate. P.D.

A92-12119

TIME VARIATION OF ELLIPTICITY OF GLOBULAR CLUSTERS IN THE LARGE MAGELLANIC CLOUD

KAZUHIRO AKIYAMA (Tokyo University, Japan) Earth, Moon, and Planets (ISSN 0167-9295), vol. 54, Sept. 1991, p. 203-239. refs

(Contract MOESC-02952007)

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N-body simulations are conducted with attention to time evolution in the ellipticity of the globular clusters in order to examine the dynamical evolution of the clusters in the Large Magellanic Cloud (LMC). A binary globular cluster is merged with an elliptical cluster, and two-body relaxation and the LMC's tidal field act upon the shape of the combined body. The inner region becomes rounder because gravothermal contraction causes outward angular momentum transport, and the time scale of the decreasing ellipticity is determined in a relative temporal sense. Observed ellipticity data corresponding to the half-mass radius of LMC clusters are analyzed in terms of the results of the N-body simulations. Based on the relaxation and crossing times for the observed clusters, the effective time for achieving roundness is examined. The observed ellipticities are shown to be consistent with the proposed timescale related to the results of the simulation. C.C.S.

A92-12211

RADIO CONTINUUM OBSERVATIONS OF THE SAGITTARIUS C COMPLEX AT 22 GHz

MASATO TSUBOI, HIDEYUKI KOBAYASHI, MASATO ISHIGURO (Nobeyama Radio Observatory, Minamimaki, Japan), and YASUHIRO MURATA (Tokyo University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. L27-L35. refs

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The 22.3-GHz continuum emission of the Sgr C complex was observed using the Nobeyama Millimeter Array. It was found that the Sgr C complex has a U-shaped ridge comprising several clumpy features as well as shell-like features. The spectral index of these features suggests optically thin thermal emission embedded in the nonthermal component. A barlike structure, noticed in a previous 1.7-GHz continuum observation, is already very weak at 22.3 GHz. The steep spectrum of this barlike structure is consistent with a nonthermal origin. The Sgr C complex is located at the end of the elongated molecular cloud in the Galactic center region. The close relations of morphology and velocity between the Sgr C complex and the molecular cloud suggest that the Sgr C complex is an H II region physically interacting with the molecular cloud in the Galactic center region. Author

A92-12212

PECULIAR VELOCITY FIELD AROUND SUPERCLUSTERS - THE EFFECT OF ASPHERICITY

TAKUYA WATANABE and SHOGO INAGAKI (Kyoto University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 413-426. Research supported by Yamada Science Foundation. refs

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The evolution of oblate spheroids in uniform expanding backgrounds is investigated. An approximate solution which is valid for density contrast lower than 10 is derived. It is found that the value of the cosmological density, determined from a Virgocentric flow model, can be appreciably different from that determined from the present spheroidal model. C.A.B.

A92-12213

EXTRACTION OF ROTATING ENERGY FROM A BLACK HOLE BY A FROZEN-IN MAGNETIC FIELD IN ACCRETION FLOW

MASAYOSHI YOKOSAWA, TOSHIHISA ISHIZUKA, and YOICHI YABUKI (Ibaraki University, Mito, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 427-447. refs

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The nonstationary magnetic field produced by stationary accretion is investigated in order to examine the possible structure of the magnetic field formed around a black hole. A strongly winding field is formed around the event horizon. This horizon is observed as being wrapped by a bundle of magnetic field lines, although the toroidal component of the field in a comoving frame of particles is not in excess of the radial one. The nonstationary solution of the magnetic field is used to discuss the dynamical evolution of the energy density distribution of the field as well as energy transfer through the surface of a stretched horizon. The electric energy generation caused by the interaction of an infalling magnetized plasma with the accretion disk is also discussed. C.A.B.

A92-12215

DYNAMICS OF A SELF-GRAVITATING GAS DISK IN AN OVALLY DISTORTED GRAVITATIONAL POTENTIAL

MASATAKA FUKUNAGA and MAKOTO TOSA (Tohoku University, Sendai, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 469-484. refs

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The dynamical behavior of a self-gravitating gaseous disk is studied in the central region of a galaxy in response to a fixed, ovally distorted gravitational potential. The gas disk is modeled as an ensemble of inelastically interacting gas clouds and followed using an N-body simulation. To observe the behavior of gas near the center, gas flow within a few turn-over-radii of the rotation curve is simulated. The gas accumulates and forms an oval ring at the turn over radius, where the rotation curves switches from an inner rigid type to another differential type. As the self-gravitation of the gas increases, the ring becomes asymmetric and a large gas clump appears at either end of the major axis of the bar; if the gas mass amounts to more than 10 percent of the total mass, the asymmetry of the flow and gas clumping increases, the gas flow becomes highly unsteady and occasionally the gas passes through the very center of the galaxy, indicating a dynamical inflow of gas to the center. This could provide a fueling mechanism for activities in galactic nuclei. Author

A92-12216

POSSIBLE MODEL SPECTRA FOR BRIGHT LOW-MASS X-RAY BINARIES

REIUN HOSHI (Rikkyo University, Tokyo, Japan) and KAZUHIRO MITSUDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 485-499. refs

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Consideration is given to correlation curves in the X-ray color-color diagrams of bright low-mass X-ray binaries, particularly

GX 5-1 and Cyg X-2. In order to observe the spectral change along these curves, model spectra consisting of the sum of a hard and a soft component, approximating the X-ray emission from the neutron-star surface and the accretion disk, are adopted. The physical parameters involved in the model spectra are determined by fitting the model spectra to the observed color-color and color-intensity diagrams of GX 5-1 and Cyg X-2. The conclusion given by Mitsuda et al. (1984) that in the normal branch the temperatures of the hard and the soft components remain stable, whereas the emission area increases from the lower left to the upper right, is confirmed. C.A.B.

A92-12217**X-RAY SPECTRUM OF HERCULES X-1 IN THE LOW STATE OF THE 35-DAY CYCLE**

TATEHIRO MIHARA, TAKAYA OHASHI, KAZUO MAKISHIMA (Tokyo, University, Japan), FUMIAKI NAGASE (Institute of Space and Astronautical Science, Sagami-hara, Japan), SHUNJI KITAMOTO (Osaka University, Toyonaka, Japan), and KATSUJI KOYAMA (Nagoya University, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 501-521. refs

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A high-quality spectrum of Her X-1 in the low-state of the 35-d cycle, obtained in 1988 with Ginga, is presented. The observed X-ray flux is 4.2×10^{-10} erg/sq cm s in energy range 2-37 keV, about 5 percent of the flux in the main-on state. A 3-Sigma upper limit for the amplitude of the 1.24 s sinusoidal pulse is 2.4 percent of the average low-state flux. The iron line shows a center energy of 6.53 ± 0.08 keV, an intrinsic FWHM of 0.8 ± 0.4 keV, and an equivalent width of 1.0 ± 0.1 keV, respectively. A comparison of the low-state spectrum with the main-on and the dip data reveals two spectral components: a 'scattered' component, showing the same spectral shape with the main-on emission, and an 'absorbed' component. The accretion disk corona (at a distance of r less than 5×10^{11} cm) and the outer edge (r greater than 2×10^{11} cm) of the disk are the likely origins for each component. The broad width of the iron line suggests contributions of fluorescent X-rays from both the outer edge region of the disk and the hot scattering region. Author

A92-12218**WEAK-LINE TO EMISSION-LINE PHASES OF PU VULPECULAE**

OSAMU KANAMITSU (Fukuoka University of Education, Munakata, Japan), YASUMASA YAMASHITA, YUJI NORIMOTO, ETUSJI WATANABE, and MASAMI YUTANI (National Astronomical Observatory, Mitaka, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 43, no. 3, 1991, p. 523-545. refs

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This study presents three-color photometry and spectroscopic monitoring observations of PU Vulpeculae made at Okayama from 1983 through 1989. Variable degrees of line weakening and a UV excess were found from 1983 to 1987. The weakening first appeared in Fe I and Fe II, and later also in Ti II and Sc II. B-beta was occasionally observed as an emission line during the same period. The weak-line phase continued until late 1987, when the emission lines of H Balmer, Fe II, and forbidden Fe II became dominant. An unusual brightening in the U-B color and a gradual fading of magnitude V were also observed. The radial velocity changed with an amplitude of about 50 km/s until 1985; since 1986 it has maintained an almost constant value. The origin of the line weakening is discussed in terms of a possible interaction with an emission component, and the recent activity is interpreted by a mass-accreting white-dwarf model. C.A.B.

A92-12685* Tokyo Astronomical Observatory, Mitaka (Japan).
THE EVOLUTION OF THE DIFFUSE COSMIC ULTRAVIOLET BACKGROUND CONSTRAINED BY THE HUBBLE SPACE TELESCOPE OBSERVATIONS OF 3C 273

SATORU IKEUCHI (National Astronomical Observatory, Mitaka, Japan) and EDWIN L. TURNER (Princeton University Observatory,

NJ) *Astrophysical Journal, Part 2 - Letters* (ISSN 0004-637X), vol. 381, Nov. 1, 1991, p. L1-L4. refs

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Results are presented of recent HST UV spectroscopy of 3C 273, which revealed more low-redshift Lyman-alpha absorption lines (IGM clouds) than expected from the extrapolation from high-redshift (not less than 1.6) observations. It is shown on the basis of the standard pressure confined cloud model of the Lyman-alpha forest that this result indicates a sharp drop in the diffuse cosmic UV background from 2 to 0 redshift. It is predicted that the H I optical depth will drop slowly or perhaps even increase with decreasing redshift at less than 2 redshift. The implied constraints on the density and pressure of the diffuse IGM at 0 redshift are also derived. The inferred evolution of the diffuse UV flux bears a striking resemblance to the most recent direct determinations of the volume emissivity of the quasar population. P.D.

A92-12710**CAPTURE RATE OF THE $\text{Li-7}(\text{n}, \gamma)\text{Li-8}$ REACTION BY PROMPT GAMMA-RAY DETECTION**

Y. NAGAI, M. IGASHIRA, N. MUKAI, T. OHSAKI, F. UESAWA, K. TAKEDA, T. ANDO, H. KITAZAWA (Tokyo Institute of Technology, Japan), S. KUBONO, and T. FUKUDA (Tokyo, University, Japan) *Astrophysical Journal, Part 1* (ISSN 0004-637X), vol. 381, Nov. 10, 1991, p. 444-448. Research supported by Toray Science Foundation. refs

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The reaction $\text{Li-7}(\text{n}, \gamma)\text{Li-8}$ is a trigger reaction which bridges the instability gap at mass 8 while producing heavy elements during the rapid process of primordial nucleosynthesis in the inhomogeneous big-bang models. The reaction rate was remeasured at the most probable neutron energy of 30 keV by detecting prompt gamma-rays from a captured state; 39.3 ± 6.0 micro-b was obtained. This value is 2 times larger than that recently measured and agrees with the estimated value from the thermal neutron capture cross section by using the $1/v$ law. The result is discussed in terms of both nucleosynthesis and the solar neutrino problem. Author

A92-14612 Institute of Physical and Chemical Research, Saitama (Japan).

MULTIFREQUENCY OBSERVATIONS OF BL LACERTAE IN 1988

N. KAWAI, M. MATSUOKA (Institute of Physical and Chemical Research, Wako, Japan), J. N. BREGMAN, H. D. ALLER, M. F. ALLER, P. A. HUGHES (Michigan, University, Ann Arbor), S. A. BALBUS (Virginia, University, Charlottesville), T. J. BALONEK (Colgate University, Hamilton, NY), K. C. CHAMBERS (Leiden, Rijksuniversiteit, Sterrewacht, Netherlands), G. H. MORIARTY-SCHIEVEN (JPL, Pasadena, CA) et al. *Astrophysical Journal, Part 1* (ISSN 0004-637X), vol. 382, Dec. 1, 1991, p. 508-514. Research supported by University of Wyoming and Astrophysical Research Consortium. refs

(Contract NAG5-1059; NAGW-2135; NSF AST-88-15678)

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Simultaneous multiwavelength observations of BL Lacertae were performed on two occasions separated by 1 month in 1988 June and July, covering the radio, submillimeter, infrared, optical, ultraviolet, and X-ray wave bands. In the wide-band photon spectra, the X-ray flux lies clearly above the extension of radio-ultraviolet continuum as expected. The slope of the X-ray spectra is significantly flatter than that at optical-ultraviolet regimes, and its spectral index 0.7-1.0 corresponds to the slope at submillimeter band. Comparison with earlier observations, in fact, indicates that the X-ray flux is correlated with the submillimeter band, and not with the others, and supports the SSC model. Author

A92-14620**RAYLEIGH-TAYLOR INSTABILITY IN THE ASYMMETRIC SUPERNOVA EXPLOSION**

SHOICHI YAMADA and KATSUHIKO SATO (Tokyo, University,

Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 382, Dec. 1, 1991, p. 594-602. refs
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Matter mixing by Rayleigh-Taylor instability in the jetlike supernova explosion is studied by numerical calculations of 2D hydrodynamics. It is found that: (1) the asymmetric explosion with 5 percent initial perturbation causes the same degree of matter mixing as the spherical one with 30 percent perturbation; and that (2) 30 percent initial perturbation in the jetlike explosion is sufficient to explain the mixing in SN 1987 A suggested by many observations without any subsequent instability such as nickel bubble formation. Author

A92-14624

THE ROSSELAND MEAN FREE-FREE GAUNT FACTOR OF THE DENSE HIGH-TEMPERATURE STELLAR PLASMA

NAOKI ITOH, FUMIYOSHI KUWASHIMA, KOKI ICHIHASHI, and HARUHIKO MUTOH (Sophia University, Tokyo, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 382, Dec. 1, 1991, p. 636-639. refs
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The Rosseland mean free-free Gaunt factor of the dense high-temperature stellar plasma is calculated based on both the accurate relativistic cross section and Sommerfeld's exact nonrelativistic cross section. A wide range of electron degeneracy is accurately taken into account. Comparison of the resulting free-free opacity with the electron conduction opacity is made. Author

A92-14637

THE ORIGIN OF THE PLANET AROUND PSR 1829 - 10

TAKASHI NAKAMURA (Kyoto University, Japan) and TSVI PIRAN (Jerusalem, Hebrew University, Israel) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 382, Dec. 1, 1991, p. L81-L84. Research supported by USBSF. refs
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Various scenarios for formation of a planet around a neutron star, as observed in PSR 1829 - 10 are considered. It is shown that matter, ablated from a companion 1.5 solar mass star which was orbiting around the neutron star progenitor at a distance of about 3×10^{12} cm, would be captured by the neutron star and form a disk around it. The companion star escaped from the system during the supernova event, and the observed planet was eventually formed from this disk. Author

A92-14647

MERGING OF TWO GALAXIES WITH CENTRAL BLACK HOLES

T. EBISUZAKI, J. MAKINO, and S. K. OKUMURA (Tokyo, University, Japan) Nature (ISSN 0028-0836), vol. 354, Nov. 21, 1991, p. 212-214. Research supported by MOESC. refs
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Simulations are presented of the merging of identical galaxies with and without central black holes. It is found that, when black holes are included, the merged galaxy acquires an isothermal core comparable in mass to the sum of the two initial black holes. Furthermore, the ratio of the core radius to the half-mass radius is about the same as the ratio of the black hole mass to the total galaxy mass, a result also consistent with observational evidence. These results, which can be understood by means of simple analytical arguments, suggest that most elliptical galaxies contain central black holes with masses comparable to the mass of their cores. C.D.

A92-15429

OBSERVATIONS OF 11 PROTOSTELLAR SOURCES IN TAURUS WITH NOBEYAMA MILLIMETER ARRAY - GROWTH OF CIRCUMSTELLAR DISKS

NAGAYOSHI OHASHI, RYOHEI KAWABE, MASATO ISHIGURO (Nobeyama Radio Observatory, Minamimaki, Japan), and MASAHIKO HAYASHI (Tokyo, University, Japan) Astronomical

Journal (ISSN 0004-6256), vol. 102, Dec. 1991, p. 2054-2065. refs

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Results are presented of observations of the CS(J = 2-1) line and 98-GHz continua of 11 protostellar IRAS sources made with high spatial resolution of 2.8-8.8 arcsec using the Nobeyama millimeter array (NMA). Spatially extended CS emission is detected around all the embedded sources and the two T Tauri stars DG Tau and HL Tau, while four T Tauri stars and one embedded source L1551-IRS5 have detectable 98 GHz continuum emission from unresolved circumstellar disks of 0.1 solar mass. It is inferred from the tendency of continuum emission to be detected mainly toward the T Tauri stars and CM emission to be detected toward the embedded sources among the observed sources that the T Tauri stars have circumstellar mass distribution more concentrated as disks compared to the embedded sources. Estimation of the mass accretion rate onto such disks indicates that for embedded sources with average luminosity, a significant amount of matter must be accreted onto the disks not only in the embedded phase but also in the very early T Tauri phase. C.A.B.

A92-16249

A STUDY OF (C-13)O CLOUD CORES IN OPHIUCHUS

S. NOZAWA (Nagoya University, Toyokawa, Japan), A. MIZUNO, Y. TESHIMA, H. OGAWA, and Y. FUKUI (Nagoya University, Japan) Astrophysical Journal Supplement Series (ISSN 0067-0049), vol. 77, Dec. 1991, p. 647-675. refs
(Contract MOESC-01065002)
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Results are presented of a survey of (C-13)O cloud cores in the Ophiuchus region in the north of the Rho Oph molecular cloud core by using results of a (C-12)O unbiased survey as a guide. Twenty-three (C-13)O clouds and 51 (C-13)O cores are identified. The total mass of the (C-13)O clouds is estimated to be 2000-6000 solar masses, and the typical densities of the (C-13)O cores are around 3000/cu cm. Lists of the physical parameters such as size, mass, average density, etc. are presented for all the (C-13)O clouds and cores. The mass spectrum of the (C-13)O cores is well fitted by a power law with an index value of about 1.7, similar to those published so far for the other cloud cores. The (C-13)O clouds do not exhibit a sign of active star formation; only about 10 young stellar objects are associated with the (C-13)O clouds as a whole. There are 13 promising candidates for young stellar objects formed in the cloud complex. The upper limit of the star formation efficiency is estimated at 0.3 percent. P.D.

A92-16492

ON CORE COLLAPSE

JUNICHIRO MAKINO (Tokyo, University, Japan) and PIET HUT (Institute for Advanced Study, Princeton, NJ) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 383, Dec. 10, 1991, p. 181-191. refs
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The results of a critical investigation of the behavior of the core, based on a linear stability analysis of an isothermal gas sphere, are presented. For some choices the core mass shrinks significantly, while for others it remains constant or even increases. Different physical systems correspond to these different choices. Gaseous systems such as contracting gas clouds with a heat transport based on radiative transfer exhibit a heat conductivity that decreases in the high-density core. When they are isothermal, they will increase their core mass during contraction. When heat transport takes place mostly through thermal conduction by electrons, the core mass will remain nearly constant. Stellar dynamical systems such as globular star clusters have a heat conductivity which strongly peaks toward the central regions, resulting in a rapid shrinking of the core mass. C.A.B.

A92-17316

DISCOVERY OF STRONG ABSORPTION IN THE X-RAY SPECTRUM OF SEYFERT 2 GALAXY NGC 4507

HISAMITSU AWAKI, HIDEYO KUNIEDA, YUZURU TAWARA (Nagoya University, Japan), and KATSUJI KOYAMA (Kyoto

University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. L37-L42. refs (Contract MOESC-02952008)

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An obscured nucleus was discovered in Seyfert 2 galaxy NGC 4507 with the Ginga satellite. The 2-10 keV X-ray luminosity is 3.2×10^{43} erg/s, and the continuum radiation is well described by a power law model with a photon index of $1.34 \pm 0.28/-0.25$. The column density of the obscuring matter is $(4.9 \pm 0.7) \times 10^{23}$ cm², which is sufficiently thick to hide the broad-line region and the nucleus. An iron line with equivalent width of 420 $\pm$ 100/-110 eV has also been detected in the X-ray spectrum. In order to explain the large equivalent width, a large covering factor for the matter around the nucleus is needed. The obscuration can be naturally explained in terms of a torus in the unified Seyfert model. Author

A92-17317

QUASI-PERIODIC OSCILLATIONS IN THE X-RAY FLUX FROM CENTAURUS X-3 OBSERVED WITH GINGA

TOSHIAKI TAKESHIMA, TADAYASU DOTANI, KAZUHISA MITSUDA, and FUMIKAI NAGASE (Institute of Space and Astronautical Science, Sagami-hara, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. L43-L50. refs

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Results are presented of observations of the 4.8 X-ray binary pulsar Centaurus X-3 from March 22 to 24, 1989. In addition to coherent 4.8-s pulsations, clear quasi-periodic oscillations (QPOs) were detected in the X-ray flux during a portion of the observations. The centroid frequency and the width of the QPOs were 35 ± 2 mHz and 10 ± 5 mHz, respectively. The centroid frequency of the QPOs was stable during that portion of the observation, and no correlation was found between the QPO amplitude and the X-ray energy. Constraints on QPO models, such as the Kepler frequency and beat frequency models, are discussed on the basis of the present observations of QPOs from Cen X-3. P.D.

A92-17318

ON THE POSSIBILITY OF EXCITING ONE-ARMED CORRUGATION WAVES IN RELATIVISTIC ACCRETION DISKS

SHOJI KATO (Kyoto University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 557-568. refs

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The present study examines the possibility of exciting one-armed corrugation waves by viscous processes in geometrically thin, polytropic disks for the case where the radial wavelength of the waves is shorter than the radial scale of the disk, but longer than the disk thickness. The viscosity is assumed to have a given functional dependence on density and temperature. The results show that, in the innermost region of relativistic disks, one-armed corrugation waves are very close to neutral stability (slightly damped), even though they are highly damped in the outer region where the disks are nonrelativistic. This result depends only slightly on parameters specifying the disks and the functional form of viscosity. The closeness to neutral stability in relativistic disks results from the fact that since the epicyclic frequency is low there, a density variation is essentially associated with the waves. P.D.

A92-17319

COLD SUPER-FAST MAGNETOHYDRODYNAMICAL WINDS FROM RAPID ROTATORS

MASAAKI TAKAHASHI (Nagoya University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 569-587. refs

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Relativistic ideal MHD winds in the stationary axisymmetric magnetosphere of a rapidly rotating compact object without either gravitational or pressure effects are studied. To obtain a highly accelerated wind, it is assumed that a plasma injected from a rapid rotator should pass smoothly through both the Alfvén and fast

magnetosonic points, where the poloidal velocity of the plasma equals either the Alfvén-wave speed or that of a fast magnetosonic wave. It is shown that an X-type fast magnetosonic point can exist at a finite distance. A super-fast MHD wind is allowed when a dense plasma starts to blow near the light surface with sufficiently large energy. The predicted asymptotic velocity of the super-fast MHD wind can exceed the velocity of 'Michel's minimum energy solution,' which is interpreted as giving the upper limit for the asymptotic flow velocity of winds. P.D.

A92-17320

POST-COLLAPSE EVOLUTION OF GLOBULAR CLUSTERS WITH STOCHASTIC ENERGY SOURCES

KOJI TAKAHASHI and SHOGO INAGAKI (Kyoto University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 589-606. Research supported by Yamada Science Foundation. refs

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The effects of the stochasticity of binary activity on the post-collapse evolution of globular clusters are investigated by directly integrating the Fokker-Planck equation. By comparing the present results of computations with those of continuous energy sources, it is found that the stochasticity of binary activity makes core evolution more unstable. For example, a cluster with $N = 10,000$ stars experiences chaotic gravothermal oscillations in the case of stochastic energy sources, whereas one with continuous energy sources exhibits regular oscillations. The stochasticity, however, does not have much influence on the overall features of gravothermal oscillations for clusters with large N . Author

A92-17321* Nobeyama Solar Radio Observatory (Japan).

OBSERVATIONS OF CUMULENE CARBENES, H2CCCC AND H2CCC, IN TMC-1

KENTAROU KAWAGUCHI, NORIO KAIFU, MASATOSHI OHISHI, SHIN-ICHI ISHIKAWA (Nobeyama Radio Observatory, Minamimaki, Japan), YASUHIRO HIRAHARA (Tokyo University, Japan), SATOSHI YAMAMOTO, SHUJI SAITO, SHURO TAKANO (Nagoya University, Japan), AKINORI MURAKAMI (Mitsubishi Kasei Corp., Yokohama, Japan), J. M. VRTILEK (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA) et al. Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 607-619. Research supported by U.S.-Japan Cooperative Science Program. refs

(Contract NAGW-436)

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Attention is given to the carbon chain molecule H2CCCC, detected in the dark cloud TMC-1 for the first time in the course of a molecular line survey using the Nobeyama 45-m telescope. From nine transitions observed in the frequency region of 17-45 GHz, the total column density of H2CCCC in TMC-1 is derived to be $7.5(\pm 2.0) \times 10^{12}$ cm², which is about half of the value reported in IRC + 10216. Five transitions of a related carbon chain molecule, H2CCC, were also detected in TMC-1. The column density of H2CCC obtained in TMC-1, $2.8(\pm 0.9) \times 10^{12}$ cm², is a factor of three smaller than that of H2CCCC. The ortho-to-para abundance ratios of H2CCCC and H2CCC were found to be 4.2 ± 1.5 and 5.9 ± 2.0 , respectively. The chemical reactions of these carbon-chain molecules in dark clouds are discussed. P.D.

A92-17324

DYNAMICAL INSTABILITY OF A GENERAL RELATIVISTIC ROTATING FLUID

KUNJI NAKAYAMA (Kyoto University, Japan) and TOMOYUKI HANAWA (Nagoya University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 4, 1991, p. 649-656. refs

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A necessary condition for instability is obtained for a steady, axisymmetric, general relativistic, rotating fluid under the assumption that a perturbation is adiabatic and inviscid, and that the change in the metric due to the perturbation is negligibly small.

The necessary condition for instability is that the angular velocity is not constant in the fluid. This means that only rigid rotation is stable against a Kelvin-Helmholtz instability. The physical implication of the theorem is discussed. Author

A92-17867**MERGER OF BINARY GLOBULAR CLUSTERS - CASE OF UNEQUAL MASSES**

JUNICHIRO MAKINO, KAZUHIRO AKIYAMA, and DAICHIRO SUGIMOTO (Tokyo, University, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 185, no. 1, Nov. 1991, p. 63-78. Research supported by Japan Society for the Promotion of Science and NSF. refs

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The present study discusses the merger process of binary globular clusters for a pair of unequal-mass components. The case of mass ratio 1:0.5 is calculated by means of an N-body code with 6144 particles in total. The mass exchange between the components is found to occur through the Roche-lobe overflow. The structures of the mergers are quite similar among different cases except for the central cores which retain their initial central concentrations. P.D.

A92-18057**X-RAY VARIABILITY OF GX 339 - 4 IN ITS VERY HIGH STATE**

SIGENORI MIYAMOTO, KAZUHIRO KIMURA, SHUNJI KITAMOTO (Osaka University, Toyonaka, Japan), TADAYASU DOTANI, and KEN EBISAWA (Institute of Space and Astronautical Science, Sagami-hara, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 383, Dec. 20, 1991, p. 784-807. refs

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Results are presented on observations of GX 339 - 4 performed with the large-area counters aboard Ginga when this X-ray source was in its very high state. It is shown that the X-ray energy spectrum of GX 339 - 4 consists of a low-energy component, interpreted as being due to the disk blackbody radiation, and a high-energy tail (the Comptonized blackbody component). On time scales less than several minutes, the X-rays displayed rapid time variations, interpreted as being due to the Comptonized blackbody component. On time scales greater than hours, the disk blackbody component and the Comptonized blackbody component changed independently. These changes, however, took place within some restricted regions in the X-ray hardness-ratio-intensity diagrams: a hardness ratio increasing (with the X-ray flux) branch, a hardness ratio decreasing branch, and their crossing region. I.S.

A92-18072**V/V(MAX) TEST APPLIED TO GINGA GAMMA-RAY BURSTS**

Y. OGASAKA, T. MURAKAMI, J. NISHIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan), A. YOSHIDA (Institute of Physical and Chemical Research, Wako, Japan), and E. E. FENIMORE (Los Alamos National Laboratory, NM) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 383, Dec. 20, 1991, p. L61-L64. refs

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The V/V(max) test has been applied to gamma-ray burst data from Ginga. The Ginga gamma-ray burst detector covers the relatively low energy range where most of the photons occur and thus is able to observe fainter gamma-ray bursts than previous satellites. Since the launch of the satellite in 1987, 1989 gamma-ray bursts had been detected as of the beginning of October 1990. The standard V/Vmax test has been applied to the bursts. The observed value of $V/V(\max) = 0.35 \pm 0.035$ for bursts with more than 8.6 standard deviations above background suggests a nonuniformity in the source distribution which is consistent with a Galactic origin. Details of the present analysis and cautions concerning the derived values are discussed. Author

A92-18073**X-RAY AND RADIO PULSE PHASE COMPARISON FOR PSR 1509 - 58**

N. KAWAI, R. OKAYASU, W. BRINKMANN (Institute of Physical

and Chemical Research, Wako, Japan), R. MANCHESTER (Australia Telescope National Facility, Epping), A. G. LYNE (Nuffield Radio Astronomy Laboratories, Jodrell Bank, England), and N. D'AMICO (Palermo, Università; CNR, Istituto di Radioastronomia, Bologna, Italy) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 383, Dec. 20, 1991, p. L65, L66. refs

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The measurement of the relative X-ray and radio pulse phase of rotation-powered pulsars can provide important information on the geometry of the magnetic field and on the physical conditions in the radiation generation regions. Contemporaneous observations of the pulsar PSR 1509 - 58 in X-rays with the Ginga satellite and at radio wavelengths with the Parkes radiotelescope have been used to determine this relative phase. This is the third measurement of the phase difference between the radio and high-energy pulses of a young pulsar, the others being the Crab and the Vela pulsars. It is found that the radio pulse peak leads the X-ray peak by 37 ± 3 ms or about one-quarter of the pulse period. In contrast to the two other pulsars, the X-ray emission is single-pulsed with a broad asymmetric pulse shape. Author

A92-18078**APERTURE SYNTHESIS CS(2-1) OBSERVATIONS OF A YOUNG STELLAR OBJECT GL 490 - ACCRETION FLOW IN GAS DISK**

AKIKO NAKAMURA (Kyoto University, Japan), RYOHEI KAWABE, MASATO ISHIGURO, YASUHIRO MURATA, NAGAYOSHI OHASHI (Nobeyama Radio Observatory, Minamimaki, Japan), and YOSHIMI KITAMURA (Kagoshima University, Japan) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 383, Dec. 20, 1991, p. L81-L84. refs

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Aperture synthesis CS(J = 2-1) observations of the disk structure of the dense molecular gas around the young stellar object GL 490 are performed with 4-arcsec resolution using the Nobeyama Millimeter Array. The gas is found to have a noncircular velocity of about $(1-1.5) \text{ km/s} / \sin i$ (i = inclination angle of the disk) and a mass of about 10 solar masses inside an 8500 AU region of the disk. According to the disk orientation indicated from one-sided cone-shaped optical and IR nebulosities, and the bipolar CO outflow, the noncircular motion is interpreted as inflow. The accretion time scale of the gas is estimated to be about 30,000 yr and the mass accretion rate to be 0.0003 solar mass/yr.

C.A.B.

A92-18492**THE MUNICH DUST COUNTER COSMIC DUST EXPERIMENT - RESULTS OF THE FIRST YEAR OF OPERATION**

E. IGENBERGS (Muenchen, Technische Universität, Munich, Federal Republic of Germany), A. HUEDEPOHL (BMW Rolls-Royce AeroEngines GmbH, Lohhof, Federal Republic of Germany), K. T. UESUGI, H. MIZUTANI, T. YAMAMOTO, A. FUJIMURA, H. ARAKI (Institute of Space and Astronautical Science, Sagami-hara, Japan), H. SVEDHEM (ESTEC, Noordwijk, Netherlands), H. IGLSEDER (Bremen, Universität, Federal Republic of Germany), and E. GRUEN (Max-Planck-Institut fuer Kernphysik, Heidelberg, Federal Republic of Germany) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 13 p. refs (IAF PAPER 91-470) Copyright

The Munich Dust Counter (MDC) is a scientific space experiment on board the satellite HITEN (MUSES-A mission) of Japan. The plasma, that is generated by the impact of cosmic dust particles on a target, is measured to determine mass, velocity and crude flight direction of the cosmic dust particles. The experiment and the satellite mission is described together with the results of the first year of operation of the MDC. From these measurements first results are derived, which describe the cosmic dust flux versus time, particle velocity and mass. The spatial distribution of the measured particles is shown in geocentric as well as in heliocentric coordinate systems. The directional distribution is also given, showing the different populations of cosmic dust particles. There is a clear distinction between apex particles and beta meteoroids.

Author

90 ASTROPHYSICS

A92-18951

A VERY HIGH C-12/C-13 RATIO IN SOME CH STARS - IMPLICATIONS FOR DREDGE-UP IN AGB EVOLUTION DURING THE METAL-POOR ERA

T. TSUJI, K. TOMIOKA, H. SATO (Tokyo, University, Mitaka, Japan), M. IYE (National Astronomical Observatory, Mitaka, Japan), and T. OKADA (Okayama Astrophysical Observatory, Japan) *Astronomy and Astrophysics* (ISSN 0004-6361), vol. 252, no. 1, Dec. 1991, p. L1-L4. refs
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A92-19312* Kyoto Univ. (Japan).

SELF-ORGANIZATION OF COSMIC RADIATION PRESSURE INSTABILITY. II - ONE-DIMENSIONAL SIMULATIONS

CRAIG J. HOGAN (Kyoto University, Japan; Steward Observatory; Arizona, University, Tucson) and JORDEN WOODS (Arizona, University, Tucson; Washington, University, Seattle) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 384, Jan. 1, 1992, p. 111-114. refs
(Contract NAGW-1703; NAGW-2523; NAGW-2569)
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The clustering of statistically uniform discrete absorbing particles moving solely under the influence of radiation pressure from uniformly distributed emitters is studied in a simple one-dimensional model. Radiation pressure tends to amplify statistical clustering in the absorbers; the absorbing material is swept into empty bubbles, the biggest bubbles grow bigger almost as they would in a uniform medium, and the smaller ones get crushed and disappear. Numerical simulations of a one-dimensional system are used to support the conjecture that the system is self-organizing. Simple statistics indicate that a wide range of initial conditions produce structure approaching the same self-similar statistical distribution, whose scaling properties follow those of the attractor solution for an isolated bubble. The importance of the process for large-scale structuring of the interstellar medium is briefly discussed. Author

A92-19325

TIME VARIATIONS IN THE X-RAYS FROM CYGNUS X-3 OBSERVED WITH GINGA

SHUNJI KITAMOTO, SEIKO MIZOBUCHI (Osaka University, Toyonaka, Japan), KOUJUN YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and HIROSHI NAKAMURA (Institute of Physical and Chemical Research, Wako, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 384, Jan. 1, 1992, p. 263-268. refs
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Results of time-variation analyses in the X-rays from Cyg X-3 observed with the large-area counters on board Ginga are presented. No significant modulation near 12 ms was detected. The upper limit of the amplitude in the range 10-256 Hz, assuming sinusoidal modulation and taking account of the orbital motion of the X-ray star, is 0.78 percent of the mean intensity. Aperiodic variation shorter than about 1 Hz was not detected either, but variation longer than 0.1 Hz was observed. Cross spectral analysis shows frequency-independent time lags of the soft X-ray variation. It is concluded that the X-ray-emitting region is surrounded by cold scattering matter with R/τ (tau is greater than 1) or R (tau is less than 1) = $(3-30) \times 10 \exp 11$ cm, where R and τ are the radius and the Thomson scattering optical depth, respectively. R less than $4.8 \times 10 \exp 11$ is obtained from a diplike structure observed in the light curve. The time variation during the X-ray-intense phase was greater than that during the X-ray-faint phase, which supports the stellar wind model's capacity to explain the almost sinusoidal X-ray light curve. P.D.

A92-19338* Tokyo Univ. (Japan).

X-RAY STUDY OF NGC 1399 IN THE FORNAX CLUSTER OF GALAXIES

Y. IKEBE, T. OHASHI, K. MAKISHIMA, T. TSURU (Tokyo, University, Japan), G. FABBIANO, D.-W. KIM (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA), G. TRINCHIERI (Arcetri, Osservatorio Astrofisico, Florence, Italy), I. HATSUKADE (Miyazaki University, Japan), K. YAMASHITA, and H. KONDO (Institute of

Space and Astronautical Science, Sagami-hara, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 384, Jan. 1, 1992, p. L5-L8. refs
(Contract NAG8-801)
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Observations of the cD galaxy NGC 1399 in the Fornax cluster of galaxies with Ginga have detected extended X-ray emission out to a radius of more than about 360 kpc. The energy spectrum of this emission is well fitted with an optically thin thermal spectrum with $kT = 1.46 \pm 0.05/-0.21$ keV with a strong iron emission line corresponding to an iron abundance of $1.1 \pm 1.3/-0.5$ times solar. The mass of the hot gas responsible for X-ray emission is nearly the same as the total stellar mass of the cluster. Therefore the presence of iron at near-solar abundance suggests that the mass of the hot gas ejected from galaxies is comparable to the total stellar mass. This result indicates that most of the hot gas in a very poor cluster is created through ejections from galaxies, rather than being primordial. Author

A92-20663

GINGA AND EXOSAT OBSERVATIONS OF THE PERSEUS CLUSTER OF GALAXIES

S. W. ALLEN, A. C. FABIAN, R. M. JOHNSTONE, A. C. EDGE (Cambridge University Institute of Astronomy, England), and P. E. J. NULSEN (Wollongong, University, Australia) *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), vol. 254, Jan. 1, 1992, p. 51-58. Research supported by Royal Society. refs
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Observations of the Perseus cluster of galaxies made using the Ginga and Exosat satellites are reported. Data from the Ginga satellite indicate that the region around the centrally dominant galaxy NGC 1275 is well described by a model incorporating emission from an isothermal, diffuse plasma with temperature of about 6.3 keV, metal abundance of about 0.4 solar, a cooling flow with a mass deposition rate of about 270 solar masses/yr, and photoelectric absorption from a galactic column density of $1.3 \times 10 \exp 21$ atom/sq cm. No evidence is found for a significant power-law component from the active nucleus of NGC 1275. A systematic series of pointings made with Ginga reveals no evidence for a radial dependence of metal abundance but does indicate a possibility of some large-scale temperature variation. O.G.

A92-20799 Nagoya Univ. (Japan).

X-RAY SPECTRAL VARIABILITY OF THE SEYFERT 1 GALAXY NGC 4051

HIDEYO KUNIEDA, SATIO HAYAKAWA, YUZURU TAWARA (Nagoya University, Japan), KATSUJI KOYAMA (Kyoto University, Japan), SACHIKO TSURUTA, and KAREN LEIGHLY (Montana State University, Bozeman) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 384, Jan. 10, 1992, p. 482-490. refs
(Contract NAG8-782; NAGW-2208)
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The Seyfert I galaxy NGC 4051 was observed with the Japanese X-ray astronomy satellite Ginga in 1988 May. Fast variability of a factor of two to three within 1000 s is confirmed in the soft X-ray band, and that of smaller amplitude within a few thousand seconds in the hard X-ray band. A single power-law model cannot explain all the observed energy spectra. A blob model with intrinsically almost constant photon index of about 1.9-2.0 is successfully applied to all the spectra. Intensity and spectral changes are well described by changes of intrinsic luminosity and the blob number in the line of sight. The observed variability time scale of about 2000 s implies an upper limit of the central mass of $2 \times 10 \exp 7$ solar masses. Author

A92-21931

OBSERVATIONS OF THE VELOCITY CURVES OF NGC 1068

NOBORU KANEKO (Hokkaido University, Sapporo, Japan), TETSUYA SATOH (Kutchan Agricultural High School, Abuta, Japan), KIYOTAKA TOYAMA (Hokkaido Information University, Ebetsu, Japan), MINORU SASAKI (Shimonoseki City University, Japan), MASAKI NISHIMURA (Soengakuen Research Institute of Computer Science, Sapporo, Japan), and MASAFUMI YAMAMOTO

(Fuji Photo Film Co., Ltd., Development Center, Kanagawa, Japan) *Astronomical Journal* (ISSN 0004-6256), vol. 103, Feb. 1992, p. 422-428. refs

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For 132 spectra of NGC 1068 taken at 24 position angles of every 15 deg from an isophotal major axis (P.A. = 52 deg) of the inner arm region, H-alpha, H-beta, forbidden N II 6583 A, and forbidden O III 4959 A, and 5007 A, have been measured in order to present the velocity curves in tabular form. Comparisons are made with previous observations to show that these measurements are consistent with the recent observations, but inconsistent with Walker's (1986) measurements. Combined with CO velocity data, the velocity field was analyzed to reveal large-scale noncircular motions to occur within the galaxy.

Author

A92-22355* Niigata Univ. (Japan).

TWO-COMPONENT GRAVITATING SYSTEMS AND THE RED GIANT-LIKE STRUCTURE

MASAYUKI Y. FUJIMOTO (Niigata University, Japan) and KOHJI TOMISAKA (Michigan, University, Ann Arbor) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 385, Feb. 1, 1992, p. 445-459. refs

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The present study investigates the equilibria and evolution of gravitating systems composed of two components by approximating their equations of states to polytropes. The structures are explored in hydrostatic equilibrium systematically under the condition that two components interact with each other only through gravity. The systems are found to be characterized by four parameters, the ratio of central densities and the ratio of central thermal energies per unit mass, and the polytropic indices of two components. If the central density is much higher, the structure is little affected by the presence of the other component. If the difference in the central thermal energies is smaller than specified by beta-crit, the system adopts an equilibrium configuration for any mass ratio. Two-component systems necessarily evolve to have the red giantlike structure if one component suffers cooling faster than the other. It is concluded that the red giant structure is a general characteristic of gravitating systems for which there is an appropriate mechanism to decouple the constituent into the hotter and cooler components.

C.A.B.

A92-22804

EFFECTS OF WESSON'S 5D-STM THEORY OF GRAVITY ON THE 4D UNIVERSE MODEL

T. FUKUI (Dokkyo University, Soka, Japan) *Astronomy and Astrophysics* (ISSN 0004-6361), vol. 253, no. 1, Jan. 1992, p. 1, 2. refs

Copyright

Effects of Wesson's 5D theory of gravity (1983) on cosmological quantities are studied by using Chatterjee's (1986) solution obtained for the 5D gravitational field equations in vacuum. The equation of state affected by the geometrical property of the 5th dimension suggests that our universe experienced a stiff matter state before the radiation era.

Author

A92-23327

GRAVITATIONAL CLUSTERING OF GALAXIES: COMPARISON BETWEEN THERMODYNAMIC THEORY AND N-BODY SIMULATIONS. III - VELOCITY DISTRIBUTIONS FOR DIFFERENT MASS COMPONENTS

SHOGO INAGAKI (Kyoto University, Japan), MAKOTO ITOH (Kyoto University, Uji, Japan), and WILLIAM C. SASLAW (Virginia, University; National Radio Astronomy Observatory, Charlottesville; Cambridge University Institute of Astronomy, England) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 386, Feb. 10, 1992, p. 9-18. Research supported by Yamada Science Foundation. refs

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A92-23334

ORIGIN OF FAR-INFRARED EMISSION IN SEYFERT AND STARBURST GALAXIES

HIDEAKI MOURI (Meteorological Research Institute, Tsukuba, Japan) and YOSHIKI TANIGUCHI (Kiso Observatory, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 386, Feb. 10, 1992, p. 68-82. refs

Copyright

The origin of FIR emission in starburst nuclei (SBN) and AGN is discussed by means of correlation diagrams, alpha(25, 60) vs forbidden O I/H-alpha and alpha(25, 60) vs S(1)/Br-gamma. For the SBN, it was found that there are tight correlations between alpha(25, 60) and forbidden O I/H-alpha and between alpha(25, 60) and S(1)/Br-gamma. Late-phase SBN exhibit steeper 25-60-micron slopes and larger forbidden O I/H-alpha ratios than early-phase SBN. Thus the evolutionary stage of starburst activity would be an important factor in determining the observed values of alpha(25, 60), forbidden O I/H-alpha, and S(1)/Br-gamma. For the AGN, it was found that they scatter widely in the diagrams of alpha(25, 60) vs forbidden O I/H-alpha and alpha(25, 60) vs S(1)/Br-gamma. The FIR emission of ultraluminous IR galaxies is fueled by starbursts rather than by the nonthermal source. In some AGN, the 25-60-micron slope is steeper than in the SBN, suggesting a higher population of nonionizing stars.

P.D.

A92-24244

ACCRETION IN A KERR BLACK HOLE MAGNETOSPHERE - ENERGY AND ANGULAR MOMENTUM TRANSPORT BETWEEN THE MAGNETIC FIELD AND THE MATTER

KOUICHI HIROTANI, MASAOKI TAKAHASHI, SHIN-YA NITTA, and AKIRA TOMIMATSU (Nagoya University, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 386, Feb. 20, 1992, p. 455-463. refs

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An MHD interaction between accreting matter and magnetic field in a stationary and axisymmetric magnetosphere surrounding a Kerr black hole which will exist in AGN is investigated. The critical condition that the MHD ingoing flows must pass through the fast magnetosonic point is analyzed in detail under the assumption of a magnetically dominated limit. This condition is found to restrict the shape of the magnetic field lines threading the event horizon. For example, cylindrical field lines must be bent into radial or paraboloidal ones. The plasma is expected to be injected from a thin disk into the magnetosphere and accretes to the event horizon. The fluid's energy and angular momentum are calculated both at the injection region and at the event horizon to investigate their MHG transport along the field lines. It is shown that the fluid's energy and angular momentum at the event horizon do not depend so much on the initial conditions at the injection region, but rather vary with the field line geometry near the event horizon. It is concluded that the transport process between the fluid and the magnetic field should be sufficiently effective in the accretion.

C.A.B.

A92-24272

DETECTION OF ISOCYANOACETYLENE HCCNC IN TMC-1

KENTAROU KAWAGUCHI, MASATOSHI OHISHI, SHIN-ICHI ISHIKAWA (Nobeyama Radio Observatory, Minamimaki, Japan), and NORIO KAIFU (National Astronomical Observatory, Mitaka, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 386, Feb. 20, 1992, p. L51-L53. refs

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The detection is reported of the linear HCCNC molecule, an isomer of cyanoacetylene HCCCN, in TMC-1 with the Nobeyama 45-m telescope using recent laboratory data reported by Krueger (1991). Molecular line data in the frequency range of 9-115 GHz are obtained in order to study the whole dark-cloud molecular abundance and chemistry. The frontends used in the 40- and 89-GHz regions were an SIS receiver and a cooled Schottky diode receiver, respectively, with single-sideband filters. A single line was detected at 39742.6 MGz in March 1986 with an antenna temperature of 0.33 K, which could not be assigned to any transitions of known molecules. In the line survey data, an

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unidentified line at 49677.9 MHz, which had been observed in February 1985, was also detected. The column density of HCCNC in TMC-1 is determined to be $2.9(0.2) \times 10^{12}$ /sq cm, which is 20-60 times smaller than that of HCCCN. P.D.

A92-24298

INFRARED EXTRAGALACTIC BACKGROUND LIGHT

TOSHIO MATSUMOTO (Nagoya University, Japan) IN: The galactic and extragalactic background radiation. Dordrecht, Netherlands, Kluwer Academic Publishers, 1990, p. 317-326; Discussion, p. 326. refs
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Infrared extragalactic background light plays an important role in the study of the early history of the universe, especially as a probe to search for the primeval galaxies. In the near-infrared region, UV and visible light emitted from high redshift galaxies could be observable. Measurement of the sky fluctuation at 2.2 microns gives a very low upper limit. The rocket observation of the near-infrared diffuse emission reveals isotropic emission which is possibly ascribed to an extragalactic origin. The observed brightness and fluctuation are not consistent with the standard scenario of the primeval galaxies. In the far-infrared region, integrated light of dust emission of the distant galaxies forms another cosmic background radiation. IRAS and the Nagoya-Berkeley rocket experiment found a clear correlation between H I column density and far-infrared sky brightness; however, there remains an uncorrelated isotropic emission component. If this emission is ascribed to extragalactic origin, a fairly big evolution effect is required. In the submillimeter region, excess emission over the 2.74 K blackbody spectrum was found, which requires the vast energy generation in the early universe.

Author

A92-24452

LINE PROFILE VARIATIONS CAUSED BY LOW-FREQUENCY NON-RADIAL PULSATIONS OF RAPIDLY ROTATING STARS. II

UMIN LEE (Tokyo, University, Japan; Rochester, University, NY), C. S. JEFFERY (St. Andrews, University, Scotland), and HIDEYUKI SAIO (Tohoku University, Sendai, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 254, Jan. 15, 1992, p. 185-191. Research supported by SERC. refs
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Line profile variations caused by low-frequency nonradial pulsations of rapidly rotating stars have been calculated, which take into account the temperature dependence of the absorption line equivalent width. Test calculations have been made for Si III 4553 A and He I 6678 A. The relative amplitude of temperature variation has been assumed to be comparable to the amplitude of velocity variation relative to the equatorial rotation velocity, which is reasonable for low-frequency oscillations because of the boundary condition. It is found that the effects of temperature variation exceed that of velocity variation in line profile variations. Consequently, traveling features have enough amplitude around the line center to be consistent with observations.

Author

A92-24453

THE EVOLUTION OF A BLACK HOLE'S FORCE-FREE MAGNETOSPHERE

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The structure of a stationary axisymmetric force-free magnetosphere of a Kerr black hole, and the hole's evolution due to extraction of rotational energy by the Blanford-Znajek process is examined. It is proposed that there is an 'effective' ergoregion inside the static-limit surface where the densities of 'energy at infinity' and angular momentum off the field are negative. In the outer half of the charged magnetosphere, a pulsar-type centrifugal slingshot wind blows outward, whereas in the inner half, a similar centrifugal slingshot wind blows inward. R.E.P.

A92-25483

DISC OSCILLATION MODEL FOR QUASI-PERIODIC LIGHT VARIATIONS IN CATAclysmic VARIABLES

TORU OKUDA, KAZUSHIGE ONO, MAKOTO TABATA (Hokkaido University of Education, Hakodate, Japan), and SHIN MINESHIGE (Ibaraki, University, Mito, Japan; Cambridge University Institute of Astronomy, England) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 254, Feb. 1, 1992, p. 427-434. refs
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A radial oscillation model of accretion disks for quasi-periodic light variations in cataclysmic variables is examined by means of numerical simulations. It is known that when the alpha model is used for the viscosity, accretion disks around compact objects are overstable against radial axisymmetric oscillations under a variety of conditions. The present calculations demonstrate that radial oscillations of the accretion disks around white dwarfs yield quasi-periodic oscillations (QPOs) in the disk of luminosity L_d . The calculated QPO periods are about 80-400 s for $\alpha = 0.1$ and for the mass-transfer rate of about $10 \exp 17 - 10 \exp 19$ g/s. The oscillation amplitudes range from about 0.3 to 0.6 percent of L_d and are higher for high L_d . These characteristics are in good agreement with the observations.

Author

A92-26454

THE Fe II 6149 A LINE IN THE HGMM STAR MU LEPORIS - CAN THE STAR'S MAGNETIC FIELD BE DETECTED?

MASAHIDE TAKADA-HIDAI and JUN JUGAKU (Tokai University, Hiratsuka, Japan) Astronomical Society of the Pacific, Publications (ISSN 0004-6280), vol. 104, Feb. 1992, p. 106-110. refs
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The anomalous strength of the Fe II 6149 A line relative to the Fe II 6147 A line is confirmed in the spectrum of Mu Leporis and turns out to be caused by a blending with the Hg II 6149.5 A line. This fact reveals that a magnetic field in Mu Lep cannot be reliably detected using the empirical relation for the correlation of magnetic-field strength with the difference between the equivalent widths of the two Fe II lines.

Author

A92-26621

3.3-MICRON SPECTRA OF FOUR IRAS SOURCES

HIROSHI SUTO, KOHEI MIZUTANI, and TOSHINORI MAIHARA (Kyoto University, Japan) Astronomical Journal (ISSN 0004-6256), vol. 103, March 1992, p. 927-930. refs
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The spectra between 3.15 and 3.45 microns are presented for four IRAS sources; IRAS 05355 + 3039, 06294 + 0352, 06335 + 1057, and 06210 + 1432 which possess IRAS spectra similar to reflection nebulae. The prominent emission feature at 3.3 microns of the order of $10 \exp -19$ W/sq cm has been detected in the four sources, and the adjacent feature at 3.4 microns in two of them. The 3.3-micron band strength is used to derive the contribution of small dust to the overall energy spectrum, which is about 20 percent in the 1-100-micron IR region.

Author

A92-27191

CONSTRAINTS ON THE UNIVERSE WITH A DECAYING COSMOLOGICAL CONSTANT FROM A NUMBER COUNT OF FAINT GALAXIES

YUZURU YOSHII (National Astronomical Observatory, Mitaka, Japan) and KATSUHIKO SATO (Tokyo, University, Japan) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 387, March 1, 1992, p. L7-L11. refs
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Cosmological parameters of a spatially flat universe with a decaying cosmological constant Lambda that is proposed by Peebles and Ratra are constrained from recent observations of number count of faint galaxies in the blue and near-infrared passbands. Possible combinations of density parameter Omega(0) and the index alpha which controls the decaying rate of Lambda are determined. It is found that the number count data indicate Omega(0) = 0.3-0.5 for a possible range of alpha, and that the

high-density $\Omega(0) = 1$ universe with zero space curvature is strongly disfavored by these data. Author

A92-27301

LARGE-SCALE STRUCTURE IN ISOCURVATURE BARYON MODELS

TATSUSHI SUGINOHARA (Tokyo, University, Japan) and YASUSHI SUTO (Kyoto University, Uji, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 387, March 10, 1992, p. 431-438. refs Copyright

Cosmological N-body simulations are used to investigate the formation and evolution of large-scale structure in isocurvature baryon models. The results of the simulations mainly provide constraints on the spectral index n of the primordial density fluctuations. Both the spatial and the angular two-point correlation functions of galaxies are in good agreement with the observations for $n = -1$ models. Models with $n = 0$ lead to steeper correlation functions than the observations. In fact, $n = -1$ models produce reasonably well the large-scale coherence in the peculiar velocity field as indicated by several observations. Together with the complementary constraints from the microwave background anisotropies, the acceptable parameter range of the isocurvature baryon models is severely restricted. C.A.B.

A92-27302

CONSTRAINTS ON COSMOLOGICAL MODELS WITH THE DECAYING COSMOLOGICAL CONSTANT FROM COSMIC BACKGROUND RADIATION ANISOTROPIES

NAOSHI SUGIYAMA and KATSUHIKO SATO (Tokyo, University, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 387, March 10, 1992, p. 439-442. refs (Contract MOESC-02952088) Copyright

The existence of a scalar field is favorable in the early universe. After the epoch of the inflation, the energy density of the scalar field should decrease and might behave as a time-variable cosmological constant. Using recent observations for the isotropy of the cosmic background radiation, constraints are obtained on cosmological models with the time-variable cosmological constant. It is shown that there is a possibility for the cold dark matter-dominated universe models with initially scale-invariant adiabatic perturbations to realize a spatially flat, low-density universe. To explain the long life of globular clusters, however, a very long-lived scalar field is desirable. Author

A92-27337* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE MOLECULAR HYDROGEN EMISSION AROUND L1551 IRS 5 - SHOCK-HEATED MOLECULAR GAS AT THE BASE OF THE MOLECULAR OUTFLOW

TAKUYA YAMASHITA (National Astronomical Observatory, Mitaka, Japan; Hawaii, University, Honolulu) and MOTOHIDE TAMURA (JPL, Pasadena, CA) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 387, March 10, 1992, p. L93-L96. Research supported by MOESC. refs Copyright

Spatially resolved observations of the $v = 1-0$ S(1) molecular hydrogen emission toward L1551 IRS 5 using the grating spectrometer at KPNO are presented. The S(1) emission consists of a ridge component extending toward west along the optical jet from its peak on IRS 5 and a diffuse component which traces the innermost region of the cavity enclosed by the molecular outflow. The ridge component represents shock-heated molecular gas at the root of the optical jet. The diffuse component is too bright to be of scattered origin; it most likely arises from shock-heated gas within the cavity and could represent an acceleration process of the molecular outflow. Author

A92-27365

INFRARED COSMIC BACKGROUND RADIATION

TOSHIO MATSUMOTO (Nagoya University, Japan) IN: The cosmic microwave background: 25 years later. Dordrecht, Netherlands,

Kluwer Academic Publishers, 1990, p. 187-201. refs Copyright

IR observation of the cosmic background radiation (CBR) is reviewed for the near- and far-IR and submillimeter regions. Diffuse CBR is noted in the redshifted light of first-generation stars, and some isotropic emission is attributed to extragalactic sources. Rocket-experiment data demonstrate the unexpected brightness of the submillimeter CBR related to the 2.74-K blackbody spectrum. A correlation is described between HI-column density and far-IR brightness that includes an uncorrelated component of isotropic emission in the integrated light of distant galactic dust emission. The near-IR data suggest inconsistency with standard concepts for primeval galaxies, and the far-IR data necessitate the introduction of a significant evolution effect. The sub-mm data indicate a significant generation of energy in the early universe. Reference is made to current space observation programs which can shed light on these problematic areas of CBR-related data. C.C.S.

A92-27367

COSMIC BACKGROUND RADIATION - COMPONENTS IN OTHER WAVELENGTH RANGES AND THEIR RELEVANCE TO MICROWAVE BACKGROUND

SATIO HAYAKAWA (Nagoya University, Japan) IN: The cosmic microwave background: 25 years later. Dordrecht, Netherlands, Kluwer Academic Publishers, 1990, p. 215-228. refs Copyright

The background radiation is usually contaminated by local components of galactic and solar system origins. The local components can be separated out of the cosmological component by utilizing their anisotropies in different wavelength ranges, and their contributions to spatial fluctuations are comparable to the upper limits observed to date. The cosmological components in different wavelength ranges are genetically related to each other. Models for explaining the submillimeter excess predict the background radiation in other ranges, such as in the infrared and X-ray ranges. The X-ray background is discussed by reference to recent results obtained by Ginga. Author

A92-27444

A GINGA OBSERVATION OF FO AQR - DISCLOSE ACCRETION AND MULTIPLE EMISSION COMPONENTS

A. J. NORTON (Southampton, University, England), M. G. WATSON, A. R. KING (Leicester, University, England), H. J. LEHTO, and I. M. MCHARDY (Southampton, University, England) *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), vol. 254, Feb. 15, 1992, p. 705-718. refs Copyright

A 32-hr GINGA observation of the intermediate polar FO Aqr is analyzed. The power spectrum of the X-ray light curve, constructed by means of the 1D CLEAN algorithm, indicates strong modulation at the binary-orbital, white-dwarf spin and beat periods. It is inferred from the asymmetry between the positive and negative orbital sidebands of the spin frequency that the beat modulation cannot be caused by an amplitude modulation of the spin pulse and must be intrinsic to the source. It is demonstrated that the beat is unlikely to be due to a reaction effect and as a result can only arise in a diskless accretion geometry in which the majority of the accretion flow switches from one magnetic pole of the white dwarf to the other every half a beat cycle. The use of the CLEAN algorithm applied to a GINGA time series is demonstrated, and it is employed to separate the spin-modulated components of the X-ray flux. The resulting reconstructed pulse profiles are free of contamination by any other modulation and are described in terms of multiple emission components. P.D.

A92-27725

THREE-DIMENSIONAL HYDRODYNAMIC SIMULATION OF AN ACCRETION FLOW IN A CLOSE BINARY SYSTEM

KEISUKE SAWADA (Tohoku University, Sendai, Japan) and TAKUYA MATSUDA (Kyoto University, Japan) *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), vol. 255, March 1,

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1992, p. 17P-20P. refs
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Three-dimensional hydrodynamic simulations of Roche-lobe overflow are performed by solving the Euler equations. The gas is assumed to be inviscid and adiabatic except in the case of shocks. Gas filling the critical Roche lobe of a mass-losing component flow through the L1 point towards a compact object to form an accretion disk. It is found that the accretion disk is not axisymmetric but characterized by a pair of spiral shocks, as was the case in two-dimensional calculations. Author

A92-28798 GRAVITATIONAL LENS EFFECTS ON THE DENSITY PARAMETER

HIROSHI YOSHIDA (Fukushima Medical College, Japan) and MINORU OMOTE (Keio University, Yokohama, Japan) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 388, March 20, 1992, p. L1-L3. refs
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Gravitational lens models of point mass and of spherical opaque lens are used to statistically investigate the amplification effects by gravitational lensing of local inhomogeneities on the density parameter of the universe. The effects are found to reduce the value of the density parameter measured by Loh and Spillar (1986) with an assumption of the homogeneous universe. It is shown that the gravitational lens effects of local inhomogeneities in the universe are not negligible in the observational evaluation of cosmological parameters. P.D.

A92-28827 NUMERICAL SIMULATIONS OF TWO-DIMENSIONAL AND THREE-DIMENSIONAL ACCRETION FLOWS

TAKUYA MATSUDA, TAKANORI ISHII, NOBUHIRO SEKINO (Kyoto University, Japan), KEISUKE SAWADA (Tohoku University, Sendai, Japan), EIJI SHIMA (Kawasaki Heavy Industries, Ltd., Gifu Technical Institute, Kakamigahara, Japan), MARIO LIVIO (Space Telescope Science Institute, Baltimore, MD; Technion - Israel Institute of Technology, Haifa), and ULRICH ANZER (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Federal Republic of Germany) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 255, March 15, 1992, p. 183-191. refs
(Contract MOESC-01540221; MOESC-02234206)
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Numerical simulations of 2D and 3D accretion flows past a gravitating compact object from a uniform flow at a large distance upstream are performed by solving the Eulerian equations. The 2D flows exhibit a 'flip-flop instability' if the central accreting body is small. If the central body is enlarged at some instance in the oscillating flow, then the accretion shock shows a rather periodic oscillation similar to the von Karman vortex street. In the case of 3D flows, it is found that the shock cone is much more robust than in 2D, and the flip-flop instability takes a different, probably less violent, form. The causes of the instabilities are discussed. Author

A92-28828 HARD X-RAYS FROM THE CONTACT BINARY VW CEPHEI

T. TSURU, K. MAKISHIMA, T. OHASHI (Tokyo, University, Japan), T. SAKAO (National Astronomical Observatory, Mitaka, Japan), J. P. PYE, O. R. WILLIAMS, M. A. BARSTOW (Leicester, University, England), and S. TAKANO (Institute for Molecular Science, Okazaki, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 255, March 15, 1992, p. 192-196. refs
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Ginga observations of the contact binary VW Cep are presented. The observed X-ray luminosity is 1.1×10^{30} erg/s in the energy range of 2-10 keV, assuming a distance of 31 pc. No evidence for X-ray orbital modulation or for flare events was detected. The observed X-ray spectrum is very hard, and can be represented well either by a thermal bremsstrahlung model with a temperature of 11.2 $\pm$ 4.0/-2.3 keV or a power-law model with a

photon index of 1.90 $\pm$ 0.24/-0.20. These observational results are interpreted in terms of the thermal emission from a hot coronal plasma extending beyond the stellar size. The observed upper limit on the iron K-line intensity is considerably lower than the theoretical prediction. P.D.

A92-28836 SIMULATION AND ALTERATION FOR AMORPHOUS SILICATES WITH VERY BROAD BANDS IN INFRARED SPECTRA

CHIYOE KOIKE (Kyoto Pharmaceutical University, Japan) and AKIRA TSUCHIYAMA (Osaka University, Toyonaka, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 255, March 15, 1992, p. 248-254. refs
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Amorphous silicates were synthesized by evaporation of olivine and pyroxene. It is found that amorphous condensates of olivine have nearly the same composition as source olivine. They show two very broad bands at wavelengths of 10-11 and 18-19 microns in their infrared spectra. The 18-microns band is very unstable, that is, it easily shifts to longer wavelengths by heating or hydration. On the other hand, amorphous condensates of pyroxene were enriched in Si compared with source pyroxene and showed two bands at about 9.5 and 22-23 microns. Author

A92-28929 MERIDIONAL CIRCULATION IN ROTATING STARS

TOMOFUMI NAKAKITA (Tohoku University, Sendai, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 188, no. 1, Feb. 1992, p. 41-87. refs
Copyright

The Sakurai's (1988, 1990) finite spectral method of solution of the Eddington-Vogt-Sweet (EVS) circulation is expanded, to take into account the latitudinal dependence of the angular velocity, and is used to study the redistribution of angular momentum caused by the meridional circulation in rotating stars. A rotating Cowling-type star in zero-age Main-Sequence phase is used as the basic spherical star, but the nuclear evolution of the basic spherical star is ignored. The results are used to discuss the effect of the meridional circulation on the stellar evolution. I.S.

A92-30117 CAN THE BATTERY (DEL T X DEL N) EFFECT PRODUCE 10 EXP 12 G MAGNETIC FIELDS IN NEUTRON STARS?

TAKASHI YABE (Gumma University, Kiryu, Japan), NORIAKI SHIBAZAKI (Rikkyo University, Tokyo, Japan), and HITOSHI HANAMI (Iwate University, Morioka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. L51-L56. refs
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Magnetic fields in neutron stars may be generated by a thermally-driven battery process after the star is born. The fluid motion induced in the liquid crust by this thermomagnetic process is discussed. A generalized vorticity conservation formula is derived and it is shown that fluid vortices are also generated together with the magnetic field and grow with increasing field strength. The maximum field strength produced by this process is 10 G unless the fluid velocity exceeds the velocity of sound. Even a dynamo action cannot enhance these fields beyond this critical value if the fluid motion and magnetic fields have the same origin. These results indicate that a thermomagnetic process is probably not responsible for the origin of the neutron star magnetic fields. Author

A92-30118 EXTERNAL FUELING AND STOCHASTIC IGNITION OF STARBURST IN ISOLATED GALAXIES

YOSHIAKI SOFUE (Tokyo, University, Mitaka, Japan) and KEN-ICHI WAKAMATSU (Gifu University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. L57-L64. refs
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Intergalactic gas clouds are captured by spiral galaxies due to the rampressure friction existing in gaseous halos and disks. The captured clouds are rapidly accreted toward the central region, fueling the nucleus, which may trigger starburst. This could be a triggering mechanism for starburst in isolated galaxies. Author

A92-30119**ON THE VALIDITY OF THE QUASI-LINEAR THEORY FOR THE COSMOLOGICAL THREE-POINT CORRELATION FUNCTION**

SHOGO INAGAKI (Kyoto University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. 661-669. Research supported by Yamada Science Foundation. refs

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Quasi-linear theory was found to be successful for the cosmological two-point correlation function and is shown to be inapplicable for the three-point correlation. Another important conclusion obtained is that the initial correlations equal to or higher than three-point do not affect the higher-order correlations after a sufficiently long time. Author

A92-30120**MOLECULAR RINGS IN GALAXIES AND A POSSIBLE NEW COSMIC DISTANCE INDICATOR**

YOSHIAKI SOFUE (Tokyo, University, Mitaka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. 671-683. Research supported by Japan Society for the Promotion of Science. refs

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The molecular gas distribution in the nuclear regions of galaxies can be classified into three types: a core (C) type with a high-density peak toward the nucleus; a compact-ring (CR) type with ring radius of about 200 pc; and a broad-ring (BR) type with ring radius of 750 pc. The possibility of using the ring radius as a cosmic distance indicator is examined for galaxies of up to about 100 Mpc. This geometrical method is independent of such correction factors as extinction and reddening. Author

A92-30121**PARKER-JEANS INSTABILITY OF GASEOUS DISKS**

FUMITAKA NAKAMURA, TOMOYUKI HANAWA (Nagoya University, Japan), and TAKENORI NAKANO (Nobeyama Radio Observatory, Minamimaki, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. 685-702. refs

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The magnetohydrodynamical instability of self-gravitating magnetized gaseous disks is investigated by means of a normal-mode analysis. The growth rates and eigenfunctions of unstable perturbations are obtained numerically. The perturbed disks are shown graphically. In the equilibrium model disk the Jeans mode has a larger growth rate than does the Parker mode when either the magnetic field is weak or the wavelength of the perturbation is long. The Parker instability dominates when the magnetic field is strong and the wavelength is short. The Jeans instability primarily disturbs the high-density region near the midplane; the Parker instability disturbs mainly the low-density region far from the midplane. The growth rate of the Jeans instability is at a maximum when the wave vector of the perturbation is parallel to the magnetic field. On the other hand, that of the Parker instability is at a maximum when the wavenumber in the direction perpendicular to the magnetic field is infinitely large. Author

A92-30122**TRIGGERING THE COLLAPSE OF SELF-GRAVITATING CLOUDS BY TORSIONAL ALFVEN WAVES**

ASAO HABE (Hokkaido University, Sapporo, Japan), YUTAKA UCHIDA (Tokyo, University, Japan), SATORU IKEUCHI (National Astronomical Observatory, Mitaka, Japan), and RALPH E. PUDRITZ (McMaster University, Hamilton, Canada) Astronomical Society

of Japan, Publications (ISSN 0004-6264), vol. 43, no. 5, 1991, p. 703-718. Research supported by Japan Society for the Promotion of Science. refs

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In the present paper, by adding a toroidal magnetic field a simulation is developed of the magnetic pinching process of an isothermal cloud which is stabilized by a poloidal magnetic field, and the triggering of a gravitational instability of the cloud is studied. Simulations are made by using a 3D smoothed-particle magnetohydrodynamic code for the range of physical parameters and the mass of the clump appropriate for the situation. The magnetic effects of star formation in a large-scale field can actually trigger the gravitational collapse of another clump of mass on the same flux tube which is well on the stable side of the criterion for the gravitational instability. It is suggested that this process - which takes place along a magnetic flux tube - can form a long dense streak with a triggered collapse of mass relaying the nonlinear torsional Alfvén waves. This can explain the observation of winding dense streaks in the streamers along which infrared stars line up in cases such as L1641 in Orion. Author

A92-31106**SECULAR PERTURBATIONS OF FICTITIOUS SATELLITES OF URANUS**

HIROSHI KINOSHITA and HIROSHI NAKAI (National Astronomical Observatory, Mitaka, Japan) Celestial Mechanics and Dynamical Astronomy (ISSN 0923-2958), vol. 52, no. 3, 1991, p. 293-303. refs

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Secular perturbations of fictitious satellites that are initially circular and in the equatorial plane of Uranus are discussed. Satellites located in the region where the solar perturbation is dominant become highly eccentric and inclined with respect to the equator, and have a possibility to collide with Uranus. Satellites located in the region where the oblateness perturbation is dominant keep the original eccentricity and the inclination. A scenario of a possible extinction of outer satellites of Uranus is also discussed. Author

A92-33018**SELF-SIMILAR SOLUTIONS AND THE STABILITY OF COLLAPSING ISOTHERMAL FILAMENTS**

SHU-ICHIRO INUTSUKA and SHOKEN M. MIYAMA (National Astronomical Observatory, Mitaka, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 388, April 1, 1992, p. 392-399. refs

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Self-similar solutions which describe collapsing isothermal cylinders with self-gravity are derived. The solutions are parameterized by their line masses. Their stability is also investigated by two different methods in the linear regime. One is the approximate separation of variables as an eigenvalue problem and the other is direct numerical integration of the evolution of perturbations. It is found that a self-gravitating cylinder is unstable to axisymmetric perturbations with wavelengths greater than about two times the diameter, when its line mass is nearly the same as that for equilibrium. In this case fragmentation is expected with separations of about four times the diameter. When the line mass of the cylinder greatly exceeds the value for equilibrium, perturbations do not grow much and the entire cylinder only collapses toward the axis. Therefore fragmentation is not expected as long as its collapse is isothermal. Subsequent evolution in this case is also discussed, and fragmentation is expected after or during a change in the equation of state. Author

A92-33876**A SEARCH FOR THE CO J = 1-0 ABSORPTION LINE AT Z = 2.04 TOWARD THE QSO PKS 0458 - 02**

MASATO TSUBOI and NAOMASA NAKAI (Nobeyama Radio Observatory, Minamimaki, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. L65-L68. refs

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90 ASTROPHYSICS

The CO $J = 1-0$ absorption line of a damped Ly-alpha absorber at $z = 2.04$ has been searched toward the QSO PKS 0458 - 02 using the 45-m telescope of Nobeyama Radio Observatory. The upper limits of the optical thickness as 0.024 and 0.014 at velocity resolutions of 2 and 5 km/s, respectively, have been obtained. The upper limit of the column density of CO molecules is 2.1×10^{15} exp 15/sq cm for an optical thickness of 0.024 and an excitation temperature of 20 K. Author

A92-33878

JHK IMAGING OF THE EDGE-ON SPIRAL GALAXY NGC 891
TETSUO E. AOKI (Tokyo, University, Japan), NORIHISA HIROMOTO, HIDEKI TAKAMI (Communications Research Laboratory, Koganei, Japan), and SADANORI OKAMURA (Kiso Observatory, Mitake, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 755-780. refs

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Near-IR images of NGC 891, an edge-on spiral galaxy, are presented and interpreted in terms of galactic composition and morphology with reference to existing data. The near-IR camera has a large field of view (4.2×4.2 arcmin) to allow observations of this galaxy which resembles the Milky Way and has a large apparent size. Near-IR surface photometry is used to derive the color distributions, the gas-to-dust ratio, and structure parameters, all of which are compared to those of the Milky Way. The dust lane is visible at J, H, and K, and NGC 891 is characterized as not being exactly edge-on. The gas-to-extinction ratio of the disk is similar to that of the solar vicinity, although the total ratio is twice the value of that of the Milky Way. About 20 percent of the dust in NGC 891 is warm enough to emit far-IR light; and it appears that M-supergiants are the most common objects in the galaxy. C.C.S.

A92-33879

KINEMATIC STRUCTURES OF MERGER REMNANTS
SACHIKO K. OKUMURA, TOSHIKAZU EBISUZAKI, and JUNICHIRO MAKINO (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 781-793. refs
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A set of N-body simulations of the merging of two identical spherical galaxies using a special-purpose computer, GRAPE-1 are performed. It is found that the kinematic properties of the resulting merger remnants are consistent with those of observed elliptical galaxies. The ratios of the maximum rotation velocity ($V_{\max}$) to the velocity dispersion (σ_0) are smaller than 0.6, even in the case of large impact parameters. This is in good agreement with the lack of elliptical galaxies whose ($V_{\max}$)/ σ_0 exceeds 0.6. Previous N-body calculations have contradicted the observed kinematic studies of elliptical galaxies, because relaxation was numerically enhanced due to the small number of particles (about 500). Simulations with $N = 16384$ resolve this problem. The central velocity dispersion increased by 10-20 percent through merging for a wide range of impact parameters. This increase is consistent with the Faber-Jackson relation. Author

A92-33880

SHOCK PHENOMENA IN A HYDRODYNAMIC MODEL OF A CLASSICAL CEPHEID
TOSHIHITO ISHIDA and MINE TAKEUTI (Tohoku University, Sendai, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 795-807. refs

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A hydrodynamic model of a classical Cepheid containing 500 grid points is compared with that containing 100 grid points. In linear models, the growth rates of the pulsation modes appear to grow as the number of grid points increases, and to saturate at about 200 meshes. In hydrodynamic models, some shock phenomena appear to be captured only in a 500-grid model. This indicates that a fine-grid model is very useful for studying the shock waves in a pulsating envelope. A newly constructed 500-grid

model is applied to a study of the ionization/recombination fronts and shock waves in pulsating envelopes. The motion of discontinuities over an entire pulsation cycle is shown for the first time. At the minimum radius phase it is found that (1) the shock wave in the ionized region generates much heat energy, and that (2) the radiative flux significantly increases at the shock wave in the atmosphere. The above two results indicate that the inclusion of convective energy transport and/or that of improved radiative transfer may affect the behavior of a hydrodynamic model with a strong shock. Author

A92-33881

THREE-DIMENSIONAL STRUCTURE OF ACCRETION DISKS IN CLOSE BINARY SYSTEMS

MASAHITO HIROSE, YOJI OSAKI (Tokyo, University, Japan), and SHIN MINESHIGE (Ibaraki University, Mito, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 809-821. refs

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Time-dependent, 3D particle simulations of an accretion disk interacting with an incoming stream were performed as a model for disks in close binary systems. The half-thickness of the disk, which is calculated assuming a Gaussian density profile in the vertical direction, is much larger everywhere in the outer portions of the disk than the value expected from hydrostatic balance; the ratio of the vertical height (H) to the radius (r) is on average 10-20 percent, and is especially enhanced at the eclipse phases, above 0.8 and 0.2, where H/r is about 0.15. This is a result of a violent collision of the incoming stream with disk material. The gas in the disk is hit by the stream, thereby being given a vertical velocity component, which results in material moving up and down in the vertical direction with the Keplerian time-scale of the outer rim. Finally, it is suggested that the calculated extended rim structures are quite reminiscent of what is indicated from the orbital X-ray variation in some X-ray binaries, such as the accretion disk corona sources and the dipping sources, and in some dwarf novae, such as U Gem and OY Car. Author

A92-33882

RELATIVE STRENGTHS OF MULTIPLIET LINES AS AN INDICATOR OF STELLAR MAGNETIC FIELDS

YOICHI TAKEDA (Tokyo, University, Mitaka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. 823-839. refs

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The magnetic intensification of coupled Fe II lines belonging to a common multiplet is theoretically investigated, where the relative difference (δ) in the line-strength is a good indicator of the magnetic field (H). It is shown that δ is not only a function of H , but also depends upon various other parameters; its behavior is controlled by the ratio of the Zeeman width to the Doppler width, as well as by the difference in component-patterns. Theoretical δ vs. H relations are applied to the hot Am star Omicron Peg with the results of H about 2-3 kG and microturbulence about 0 km/s, suggesting that the conventionally derived microturbulence-value of about 2 km/s may simply reflect the magnetic effect. As an alternative application, an empirical correlation between δ vs. H for cool Ap stars is examined and found to be consistent with the calculations. Author

A92-34094

THE 'INNER-HORIZON THERMODYNAMICS' OF KERR BLACK HOLES

ISAO OKAMOTO (National Astronomical Observatory, Mizusawa, Japan) and OSAMU KABURAKI (Tohoku University, Sendai, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 255, April 1, 1992, p. 539-544. refs

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The thermodynamics of the event horizons and of the inner horizons are described in a unified manner by using a dimensionless parameter H . It is defined by $h = a/rH = h_+$ on the event horizons, and varies in the range of 0 to 1, while it is also given by $h = rH/a = a/r = h_-$ on the inner horizons in the range of 1

to infinity, where $a = J/Mc$ is the angular momentum radius and $r_H = r_+$, r_- are the radii of the outer and inner horizons respectively. Every thermodynamic variable, other than the mass M and the angular momentum J , is also defined on both the outer and inner horizons, and its values form a pair of the roots of a quadratic equation with M and J contained in the coefficients, similar to the horizon radii $r_+/-$ and $H_+/-$. It is also shown that this pair of each variable constitutes mirror images of each other with respect to the extreme Kerr state. C.A.B.

A92-34624

THE X-RAY OUTBURST FROM X0115 + 634 IN 1990 FEBRUARY

KEISUKE TAMURA, HIROSHI TSUNEMI, SHUNJI KITAMOTO, KIYOSHI HAYASHIDA (Osaka University, Toyonaka, Japan), and FUMIAKI NAGASE (Institute of Space and Astronautical Science, Sagami-hara, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 389, April 20, 1992, p. 676-684. refs (Contract MOESC-03218202)

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An X-ray outburst was observed from X0115 + 634 in February 1990 with a maximum intensity of about 400 mcrab around February 11. Reasonable values for orbital parameters were obtained using a pulse timing analysis for the data when the source intensity was above 80 mcrab, but this solution could not be extended to the data around 40 mcrab or less. This suggests that the pulse profile changed around L_{crit} . Apsidal motion was detected for the first time in an X-ray pulsar, within a value of 0.030 ± 0.016 deg/yr. This value puts a constraint on the mass radius relation of the companion star which is consistent with a type B main-sequence star if Ω is greater than two. Slower rotation of the companion is excluded by these observations. The X-ray spectrum up to 60 keV was obtained, and the cyclotron absorption lines around 12 and 23 keV are confirmed. These can be understood as first and second harmonics originating from a magnetic field whose strength is about $10 \exp 12$ G. C.D.

A92-34644

GAMMA-RAY BURSTS FROM PLANET-MAGNETOSPHERE SYSTEMS AROUND NEUTRON STARS

HITOSHI HANAMI (Iwate University, Morioka, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 389, April 20, 1992, p. L71-L74. Research supported by Yukawa Memorial Foundation. refs (Contract MOESC-03249101)

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A planet-magnetosphere interaction model is studied for gamma-ray bursts with the picture of a current circuit which consists of the magnetosphere and the surface of a neutron star. The motion of planets or comets in the magnetosphere works as the battery in the circuit system. The physical condition on the surface of the neutron star is important to make a closed-current circuit inducing good conversion from the kinetic energy of a planet to that of the magnetosphere oscillation. An old and cooled neutron star with the temperature of about 10 eV can prepare the condition for closing the current circuit in the surface of the neutron star. The planet-magnetosphere system is unstable to feedback instability related to the variability of the gamma-ray bursts.

Author

A92-34657

ASTROPHYSICAL USE OF THE PRINCIPAL COMPONENT ANALYSIS OF IMPERFECT DATA

WASABURO UNNO and MANABU YUASA (Kinki University, Osaka, Japan) *Astrophysics and Space Science* (ISSN 0004-640X), vol. 189, no. 2, March 1992, p. 271-278. refs

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In natural historical studies, no uniform accuracy of observational data can generally be expected for different quantities and for different samples. Principal component analysis is generalized in such a way that maximum information can be drawn from any given set of imperfect data. The principle of the generalization is to supplement data to the given set of data so

that the combined system does attain the maximum probability distribution. The utility of the method in a few astrophysical and other applications are discussed briefly. Author

A92-35396

MIXING IN EJECTA OF SUPERNOVAE. I - GENERAL PROPERTIES OF TWO-DIMENSIONAL RAYLEIGH-TAYLOR INSTABILITIES AND MIXING WIDTH IN EJECTA OF SUPERNOVAE

IZUMI HACHISU, TAKUYA MATSUDA (Kyoto University, Japan), KEN'ICHI NOMOTO, and TOSHIKAZU SHIGEYAMA (Tokyo, University, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 390, no. 1, May 1, 1992, p. 230-252. Research supported by Institute of Space and Astronautical Science of Japan and KICFD. refs

(Contract MOESC-02234206; MOESC-02302024; MOESC-02640204; MOESC-03218202; MOESC-03218205)

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Nonlinear growth of 2D Rayleigh-Taylor (R-T) instabilities are numerically studied to apply to the mixing in the supernova ejecta. Highly refined calculations of mixing in the realistic model of SN 1987A with a better code and various mesh resolutions are presented. It is shown that mixing width (or the extent of mixing) due to Rayleigh-Taylor instabilities is still too small to account for the observations even with relatively large initial perturbation. The mixing width is found to depend only slightly on the mesh resolution when the initial amplitude is larger than about 5 percent of the expansion speed. To clarify the basic properties of the R-T instabilities and the dependence of the mixing width on the initial density structure, initial perturbation, and numerical resolution, highly simplified ideal models of R-T instabilities of compressible gas with an adiabatic constant of $4/3$ are considered. It is found that, when the initial amplitude of the velocity perturbation is larger than 1 percent of the sound speed, the mixing width in time depends mainly on the initial amplitudes and the density ratio. P.D.

A92-35809

LONG-SLIT SPECTROSCOPY OF THE CENTRAL REGIONS OF STARBURST GALAXIES - HENIZE 2-10 AND MARKARIAN 52

HAJIME SUGAI (Tokyo, University, Japan) and YOSHIKI TANIGUCHI (Kiso Observatory, Tokyo, Japan) *Astronomical Journal* (ISSN 0004-6256), vol. 103, no. 5, May 1992, p. 1470-1483. refs

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Long-slit spectroscopic observations have been made for the two starburst galaxies He 2-10 and Mrk 52, and the physical conditions of the starburst regions in galactic nuclei are discussed. H-alpha emission is strongly concentrated in the central 70 and 300 pc regions in He 2-10 and Mrk 52 respectively. This is evidence for nuclear starbursts in both galaxies. The H-alpha equivalent widths are 310 and 230 Å for He 2-10 and Mrk 52, respectively, values comparable to those of giant and supergiant H II regions. Thus, the starburst phenomena that occurred in the two nuclei continued for a comparable time to that of the OB associations in giant and supergiant H II regions in disks. Based on forbidden S II double ratios, the electron densities of the nuclear ionized regions in both galaxies are to the order of $1000/\text{cm}^3$, decreasing outward to the order of $100/\text{cm}^3$. The filling factors are comparable to the highest values in giant and supergiant H II regions. C.D.

A92-35824

M17SW GIANT COLD H I CLOUD

FUMIO SATO (Tokyo Gakugei University, Koganei, Japan), JOHN B. WHITEOAK, ROBINA E. OTRUPCEK (Australia Telescope National Facility, Epping), and TETSUYA TOKUSHIGE (Tokyo Gakugei University, Koganei, Japan) *Astronomical Journal* (ISSN 0004-6256), vol. 103, no. 5, May 1992, p. 1627-1631. refs

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The M17SW giant molecular cloud (GMC) is mapped in the 21-cm absorption line with the Parkes 64-m telescope. The cold H I cloud in the region has a total extent of over 120 pc and

consists of three major fragments with different ages. The main part of the youngest fragment has not been found in CO lines, but it is probably bound gravitationally with an H₂ density of about 80/cu cm. Such diffuse molecular gas in the cold H I cloud nearly doubles the total mass previously estimated in the M17SW GMC from molecular line observations. The three H I fragments are arranged in order of decreasing age in the direction of passage of a shock associated with the galactic density wave. This suggests that the galactic shock plays an important role in cloud formation in the region. Author

A92-36761

FORMATION OF A GIANT GALACTIC GASEOUS HALO - METAL ABSORPTION LINES AND HIGH-VELOCITY CLOUDS
FAN LI and SATORU IKEUCHI (National Astronomical Observatory, Mitaka, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 390, no. 2, May 10, 1992, p. 405-422. refs
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A 2D axisymmetric hydrodynamic code based upon the chimney model of the interstellar medium - a new version of a galactic fountain - is used to simulate a Galactic gaseous halo formed through the interstellar disk-halo connection. The abundance of each ion of H, He, and heavy elements is calculated according to the hydrodynamic and thermal state of the halo gas in order to reproduce the column densities of C IV, N V, O VI, and Si IV in the observed absorption lines of halo stars. The distribution and ballistic motions of the clouds in the Galactic gravitational field are calculated on the assumption that the radiatively cooled halo gas condenses into clouds due to thermal instabilities. It is found that a cooled-type halo with gas temperature between 500,000 and 1,000,000 K and density between 0.001 and 0.01/cu cm at the disk-halo interface can reproduce observational facts about the Galaxy. It is concluded that C IV systems greater than 50 kpc correspond to the wind-type halo, and that Mg II and Ca II systems can be detected in a very restricted region (not greater than 20 kpc). C.A.B.

A92-36783

SPIRAL SHOCKS AND SUBDAY VARIABILITY IN SS 433
SANDIP K. CHAKRABARTI and T. MATSUDA (Kyoto University, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 390, no. 2, May 10, 1992, p. 639-644. refs
(Contract MOESC-03640267)
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A two-dimensional numerical simulation of fluid hydrodynamics in the accretion disk of the SS 433 system is performed. It is shown that the disk must have quasi-stationary two-armed spiral shocks. The blackbody spectrum of the disk is calculated. The spectrum clearly shows subday variabilities in the optical component. Future observation of such a variability could throw more light on the nature of the SS 433 system. It is suggested that the spiral shocks provide the necessary viscosity to sustain a supercritical accretion. Author

A92-36800

BIPOLAR OUTFLOW IN B335 - THE SMALL-SCALE STRUCTURE

NAOMI HIRANO (Hitotsubashi University, Kunitachi, Japan), OSAMU KAMEYA (Mizusawa Astrogeodynamics Observatory, Japan), TAKASHI KASUGA (Hosei University, Koganei, Japan), and TOMOFUMI UMEMOTO (Nobeyama Radio Observatory, Minamimaki, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 390, no. 2, May 10, 1992, p. L85-L88. refs
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The young stellar object in B335 is studied with interferometric observations to determine the scale of the outflow collimation and the structural attributes of the outflow and the disk. Observations with high angular resolution are described that address the (C-12)O ($J = 1-0$) and 2.6-mm-continuum emission. A biconical outflow structure is identified in the (C-12)O high-velocity emission that is focused with approximately 1000 AU of its origin. A 2.6-mm-continuum source with a peak flux of approximately 80 mJy identified within about 4 arcsec of the outflow center indicates

that a very dense field of n(H₂) of more than about 10×10^8 /cu cm surrounds the object. The dense material is thought to both drive and collimate the outflow, and a model is proposed that accounts for the increase in velocity away from the center observed near the origin. The dynamical model describes the velocity field of B335's outflow with acceleration and deceleration in regions of certain ambient density gradients. C.C.S.

A92-37717

X-RAY SPECTRUM AND TIME VARIATION OF X1850 - 087 IN THE GLOBULAR CLUSTER NGC 6712

SHUNJI KITAMOTO, HIROSHI TSUNEMI (Osaka University, Toyonaka, Japan), and DIANE ROUSSEL-DUPRE (Los Alamos National Laboratory, NM) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 391, no. 1, May 20, 1992, p. 220-227. Research supported by DOE. refs
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The energy spectrum and the time variation of the X-rays from X1850 - 087 in the globular cluster NGC 6712 was observed with the Large Area Counter on board Ginga. The luminosity of X1850 - 087 was 1.3×10^{36} (D/6.8 kpc)² ergs/s. The X-ray energy spectrum can be represented by a single power-law type spectrum with a photon index of 2.3, with an interstellar absorption of less than 10×10^{21} H atoms/sq cm. A model consisting of disk blackbody and radiation from the neutron star requires an unphysically small inner-disk-radius and a small emission region on the neutron star surface where allowances have been made for the difference between the color temperature and the effective temperature. On the other hand, a model where the main X-ray formation mechanism is Compton scattering indicates that the plasma, which is responsible for Compton scattering, becomes thin and hot in the low accretion rate state. No significant periodic variation was detected, but a significant variation below 1 Hz was found, which is similar to a HF noise observed in the island state of the atoll sources. Author

A92-37728

COLLISION AND TIDAL INTERACTION BETWEEN PLANETESIMALS

SEI-ICHIRO WATANABE (Yamagata University, Japan) and SHOKEN M. MIYAMA (National Astronomical Observatory, Mitaka, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 391, no. 1, May 20, 1992, p. 318-335. refs
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Evolution of two encountering planetesimals in the solar gravitational field is simulated using a 3D smoothed-particle hydrodynamics code in order to obtain the precise coalescence probability including the effects of tidal forces and shock compression on two-body interaction, one of the elementary processes in planetary accumulation. The enlargement factor of the coalescence radius takes its maximum value of 1.7 when the two bodies have uniform density distributions and zero initial relative velocity. The factor decreases with increases in central mass concentration and/or in initial relative velocity. In the cases with initial velocity exceeding 0.5 x their escape velocity, the tidal enhancement of coalescence radius cannot be expected. The amount of escaping mass from the merger after collision is less than a few percent of the total mass in the cases with initial velocities lower than the escape velocity. Author

A92-37742

CANONICAL TIME VARIATIONS OF X-RAYS FROM BLACK HOLE CANDIDATES IN THE LOW-INTENSITY STATE

SIGENORI MIYAMOTO, SHUNJI KITAMOTO, SAYURI IGA, HITOSHI NEGORO, and KENTARO TERADA (Osaka University, Toyonaka, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 391, no. 1, May 20, 1992, p. L21-L24. refs
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The power spectrum density functions of X-rays and the phase lags of the time variations between different energy X-rays were investigated for several black-hole candidates (Cyg X - 1, GX 339 - 4, and GS 2023 + 338) in their low-intensity state, to determine whether these density functions were different for different X-ray

sources and at different occasions for the same source. The results suggest that, in these black hole candidates in the low-intensity state, the X-ray production process and the dynamics of accreting matter behavior are the same except for the processes which correspond to the Fourier frequencies below about 0.2 Hz. I.S.

A92-41073

ON A CLASS OF VARIATIONAL EQUATIONS TRANSFORMABLE TO THE GAUSS HYPERGEOMETRIC EQUATION

HARUO YOSHIDA (National Astronomical Observatory, Mitaka, Japan) Celestial Mechanics and Dynamical Astronomy (ISSN 0923-2958), vol. 53, no. 2, 1992, p. 145-150. refs Copyright

A new class of linear ordinary differential equations with periodic coefficients is found which can be transformed to the Gauss hypergeometric equation. Therefore, the monodromy matrices are computable explicitly. These equations appear as the variational equations around a straight-line solution in Hamiltonian systems of the form $H = T(p) + V(q)$, where $T(p)$ and $V(q)$ are homogeneous functions of p and q , respectively. Author

A92-41349

AHARONOV-BOHM SCATTERING BY VORTICES OF DIMENSIONALLY-REDUCED YANG-MILLS FIELD

KIYOSHI SHIRAIISHI (Ochanomizu University, Tokyo, Japan) and ATSUSHI NAKAMURA (Tokyo Metropolitan University, Japan) Czechoslovak Journal of Physics (ISSN 0011-4626), vol. 42, no. 3, March 1992, p. 285-289. Research supported by Soryuusi Shogakukai and Iwanami Fujukai. refs Copyright

The Aharonov-Bohm (A-B) scattering of low-energy fermions by a 4D Yang-Mills gauge field is considered theoretically in the context of a cosmic-string model with 6D matter fields. Two dimensions of the 6D space-time are compactified to derive the 4D cosmic string from the gauge field, and fermions are introduced in a fundamental representation of $SU(2)$ as a matter field. The scattering of a massless fermion is observed, and the effective charge of the fermion is half of the unit when the space-time is reduced. C.C.S.

A92-42425

THE RING AROUND SN 1987A AND ROTATION OF THE PROGENITOR

Y. ERIGUCHI, H. YAMAOKA, K. NOMOTO (Tokyo, University, Japan), and M. HASHIMOTO (Kyushu University, Fukuoka, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 392, no. 1, June 10, 1992, p. 243-248. refs (Contract MOESC-02302024; MOESC-02234204; MOESC-02640198; MOESC-03218202; MOESC-03250204) Copyright

Attention is given to two rotational effects of the progenitor of SN 1987A, namely, mass-shedding from the equator and an aspherical mass distribution in a stellar wind due to the direction-dependent mass loss. It is found that, if the rotational velocity of the progenitor at the main sequence exceeds 270 km/s, mass-shedding can occur at the blue supergiant stage. This is due to the decreasing amount of inertia along the evolution with increasing mass concentration toward the center. The observed abundances and the expansion velocity of the ring provide rather severe constraints on the time of mass-shedding, which suggests that the mass-shedding scenario is less likely the case. The stellar wind combined with the rotation forms an aspherical mass distribution in the distant region from the star. The nonsphericity can be 10-20 percent depending on the ratio of the rotational energy to the gravitational energy. C.A.B.

A92-42443

INTERGALACTIC IONIZING FLUX FROM ACTIVE GALACTIC NUCLEI

NOBUO TERASAWA (Institute of Physical and Chemical Research, Wako, Japan) Astrophysical Journal, Part 2 - Letters (ISSN

0004-637X), vol. 392, no. 1, June 10, 1992, p. L15-L18. Research supported by Institute of Physical and Chemical Research. refs Copyright

Recently the appreciation that the X-ray background is the superposition of the X-ray emission from low-luminosity active galactic nuclei (AGNs), has been generalized. AGNs are also powerful emitters of the ultraviolet radiation and the intergalactic ionizing flux is possibly supplied by them. The metagalactic ionizing flux from AGNs are evaluated on the basis of the X-ray luminosity function and the luminosity evolution of AGNs. The predicted UV flux is consistent with the proximity effect on the Lyman-alpha clouds and the optical depth of intergalactic matter against the ionizing photons satisfy the Gunn-Peterson test for the high-redshift quasars. The evolution of the ionizing flux is also consistent with the evolution law determined by a pressure confinement model of the Lyman-alpha clouds. Author

A92-42964

A SYSTEMATIC SURVEY FOR DENSE CORES IN NEARBY STAR FORMATION REGIONS

YASUO FUKUI, A. MIZUNO, T. NAGAHAMA, K. IMAOKA, and H. OGAWA (Nagoya University, Japan) (Vulcano Workshop on Young Star Clusters and Early Stellar Evolution, Vulcano, Italy, Sept. 16-20, 1991, Proceedings. A92-42951 17-90) Societa Astronomica Italiana, Memorie (ISSN 0037-8720), vol. 62, no. 4, 1991, p. 801-812. refs

Some of the first results of a survey for dense cores in the C(O-18) $J = 1-0$ and CS $J = 2-1$ emission in nearby star formation regions are presented. CS $J = 2-1$ maps covering the Ori A cloud including L1641 and the Rho Oph main cloud, and a C(O-18) map of Taurus as well as (C-13)O maps are provided. High star formation efficiency is found in regions with remarkable concentrations of dense molecular gas; they are the Ori KL region and the Rho Oph main cloud. In low mass dense cores, isolated stars or small low mass clusters appear to be formed. Two stellar clusters with 10-20 low mass members are known to exist in L1641 from near IR studies by Chen et al. (1991). They are associated with L1641-North and L1641-Center outflows, respectively, and are accompanied by low-intensity CS clumps of about 1-2 K km/s peak intensity. P.D.

A92-42965

MOLECULAR CLOUD CORES IN THE ORION A CLOUD

KEN'ICHI TATEMATSU and T. UMEMOTO (Nobeyama Radio Observatory, Minamimaki, Japan) (Vulcano Workshop on Young Star Clusters and Early Stellar Evolution, Vulcano, Italy, Sept. 16-20, 1991, Proceedings. A92-42951 17-90) Societa Astronomica Italiana, Memorie (ISSN 0037-8720), vol. 62, no. 4, 1991, p. 813-821. Research supported by MOESC. refs

Molecular cloud cores in the Orion A giant molecular cloud are studied through an extensive, high-resolution survey with the Nobeyama 45 m telescope. The physical parameters of 125 molecular cloud cores, which have been identified from the CS(1-0) data are discussed. The average core radius is 0.16 pc, which is comparable to the value obtained for cores in dark clouds. On the other hand, the Orion molecular cloud cores have larger CS line width and larger core mass than those in dark clouds, which are the sites of low-mass star formation. In the Orion A cloud, the line width and core mass tend to be larger in the northern part, where the mass of stars being formed is also larger. The mass spectrum of the Orion cores is fitted by dN is proportional to $M \exp -1.8 dM$ for M greater than or equal to 30 solar masses. It seems that prominent young clusters tend to accompany massive cores. Author

A92-42968

MAGNETIC FIELDS IN ACCRETION DISKS AROUND PROTOSTARS AND FRAGMENTATION OF THE DISKS

TAKENORI NAKANO (Nobeyama Radio Observatory, Minamimaki, Japan) (Vulcano Workshop on Young Star Clusters and Early Stellar Evolution, Vulcano, Italy, Sept. 16-20, 1991, Proceedings. A92-42951 17-90) Societa Astronomica Italiana, Memorie (ISSN

90 ASTROPHYSICS

0037-8720), vol. 62, no. 4, 1991, p. 841-846. refs
(Contract MOESC-03249105)

The behavior of magnetic field in accretion disks around protostars is investigated. Using the alpha model for a steady accretion disk with a constant plasma beta (gas pressure/magnetic pressure) the magnetic field is found to be decoupled from the gas only at a certain radius. Because the magnetic torque is inefficient at r approximately less than $r(d)$, the efficiency of angular momentum transport is low, and then the density is high. It is found that the disk becomes gravitationally unstable and breaks into fragments of mass 0.01 solar mass at r approximately equals $r(d)$. Author

A92-43569

ANISOTROPY OF SPACE

MASATAKA MIZUSHIMA (Tokyo, University, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 61, no. 4, April 1992, p. 1125, 1126. refs
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When a point mass (radiator) is moving with speed v on a circular orbit around another massive point mass (accelerator) at a distance r , the metric seen by an observer far from the accelerator but close by and moving with the radiator, shows space anisotropy. The value of this anisotropy is $10 \exp -12$ for the sun, accelerated by the center of the Milky Way, and is $4 \times 10 \exp -16$ for earth, accelerated by the sun. Brillet and Hall's experiment, which claims accuracy to $5 \times 10 \exp -14$ for the anisotropy of space, can detect the predicted anisotropy near the sun if the detector is modified properly. Author

A92-43587

LINE PROFILES EMITTED FROM AN ACCRETION TORUS

YASUFUMI KOJIMA (Tokyo Metropolitan University, Hachioji, Japan) and JUN FUKUE (Osaka Kyoiku University, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 256, no. 4, June 15, 1992, p. 679-684. refs
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On the assumption that large-radii emission dominate, the present calculation of a geometrically thick accretion disk's emission-line profile neglects all general relativistic effects. A flat-topped profile is observable if the angle between the line-of-sight and the rotation axis is between a critical angle larger than the inclination of the torus' funnel wall to the rotation axis and 180 deg minus that critical angle. The critical angle decreases with increasing torus thickness. O.C.

A92-43588

WAVE ACTION CONSERVATION, OVER-REFLECTION AND OVER-TRANSMISSION OF NON-AXISYMMETRIC WAVES IN DIFFERENTIALLY ROTATING THIN DISCS WITH SELF-GRAVITY

YOSHITSUGU NAKAGAWA (Tokyo, University, Japan) and MINORU SEKIYA (Teikyo University, Utsunomiya, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 256, no. 4, June 15, 1992, p. 685-694. refs
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The present examination of the effects of self-gravity on the over-reflection phenomena of linear nonaxisymmetric waves in differentially-rotating Keplerian disks uses coordinates that move with the unperturbed differential rotation. The transmission coefficient T and the reflection coefficient R of waves are obtained as functions of the normalized azimuthal wavenumber for various values of the self-gravity parameter. The results obtained indicate that self-gravity significantly enhances wave amplification. The phenomenon may be understood by analogy with the one-dimensional Schroedinger equation. O.C.

A92-43639

INTERSTELLAR NA-22 AND THE EXCESS NE-22 IN THE GALACTIC COSMIC RAY SOURCE

SHOHEI YANAGITA (Ibaraki University, Mito, Japan) and KEN'ICHI

NOMOTO (Tokyo, University, Japan) IN: Gamma-ray line astrophysics; Proceedings of the International Symposium, Paris, France, Dec. 10-13, 1990. New York, American Institute of Physics, 1991, p. 193-195. refs

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The role of novae outburst as a source of the excess Ne-22 at the Galactic Cosmic Ray source is reexamined quantitatively. Isotopes Ne-22 which are the daughter nuclei of radioactive Na-22 synthesized in novae outbursts get excess energy over thermal particles due to nuclear recoil effects by beta-decay and can preferentially be injected as cosmic ray seeds into the shock wave at nova explosion where particles are accelerated. The excess Ne-22 can be explained if a fraction of $4.5 \times 10 \exp -4$ of the total production of Ne-22 via Na-22 in novae is accelerated. The implications of this scenario are discussed with possible observations of the 1.275 MeV gamma ray line from novae. Author

A92-43644

GAMMA-RAY LINES FROM TYPE IB/IC SUPERNOVAE AND SN 1987A

K. NOMOTO, S. KUMAGAI, and T. SHIGEYAMA (Tokyo, University, Japan) IN: Gamma-ray line astrophysics; Proceedings of the International Symposium, Paris, France, Dec. 10-13, 1990. New York, American Institute of Physics, 1991, p. 236-256. refs
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Gamma-ray lines expected from helium star models for type IB/IC supernovae (SN IB/IC) are presented. Summarized are: (1) presupernova evolution that may lead to the difference between SN IB and SN IC; (2) nucleosynthesis and isotopic abundances in the exploding helium stars with 3-8 solar masses, and their mass dependence; (3) 2D hydrodynamical simulations of Rayleigh-Taylor instabilities and mixing; (4) optical light curves of these helium stars, and the dependencies on the stellar mass and the degree of mixing; and (5) X-ray/gamma-ray spectra and gamma-ray line light curves originated from radioactive decays, their dependencies on the stellar mass and mixing. The possibilities that INTEGRAL and GRO detect gamma-ray lines and hard X-rays from nearby SNe IB/IC are discussed. Also discussed are the implications of recent change in the bolometric light curve of SN 1987A as well as the updated comparison between the calculated X/gamma-ray line light curves and observations. Author

A92-43720

A SURVEY OF CCS, HC3N, HC5N, AND NH3 TOWARD DARK CLOUD CORES AND THEIR PRODUCTION CHEMISTRY

HIROKO SUZUKI (Nobeyama Radio Observatory, Minamimaki, Japan), SATOSHI YAMAMOTO (Nagoya University, Japan), MASATOSHI OHISHI (Nobeyama Radio Observatory, Minamimaki, Japan), NORIO KAIFU (National Astronomical Observatory, Mitaka, Japan), SHIN-ICHI ISHIKAWA (Nobeyama Radio Observatory, Minamimaki, Japan), YASUHIRO HIRAHARA (Tokyo, University, Japan), and SHURO TAKANO (Nobeyama Radio Observatory, Minamimaki, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 392, no. 2, June 20, 1992, p. 551-570. Research supported by Morino Science Foundation. refs
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Survey observations of CCS, HC3N, HC5N, and NH3 were carried out toward 49 dark cloud cores to examine the existence of a systematic relation between the chemical evolution and the physical evolution of dark clouds. The CCS radical was revealed to be abundant in cold and quiescent dark cloud cores, while it is much less abundant in star-forming regions. The column density of CCS shows a good positive correlation with those of HC3N and HC5N, indicating that the production chemistry of CCS is closely related to those of other carbon-chain molecules in dark clouds. On the other hand, the column density of CCS shows no correlation with that of NH3; NH3 tends to be abundant in star-forming regions. A possible chemical model for the production of CnS ($n = 1-3$) is proposed. Pseudo-time-dependent calculations based on the proposed model show that the calculated abundance of CCS in the early stage of chemical evolution agrees mostly with the observed value in TMC-1. The relations among the

observed column densities are qualitatively interpreted as an effect of chemical evolution of dark clouds on the basis of simulation of the molecular synthesis; carbon-chain molecules including CCS are abundant in the early stages of chemical evolution, whereas NH₃ is abundant in the later stages. Author

A92-43723

HIGH SPATIAL RESOLUTION OBSERVATIONS OF HCO(+) IN THE NGC 7027 MOLECULAR ENVELOPE

S. DEGUCHI (Nobeyama Radio Observatory, Minamimaki, Japan), H. IZUMIURA (Tokyo Gakugei University, Koganei, Japan), NGUYEN-Q-RIEU (Paris, Observatoire, Meudon, France), K. M. SHIBATA, N. UKITA (Nobeyama Radio Observatory, Minamimaki, Japan), and I. YAMAMURA (Tokyo, University, Japan) *Astrophysical Journal, Part 1* (ISSN 0004-637X), vol. 392, no. 2, June 20, 1992, p. 597-601. refs
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A92-43727

THE NONEXPONENTIAL EVOLUTION OF PULSAR MAGNETIC FIELDS

SHIGETO WAKATSUKI, ATSUSHI HIKITA, NAOHIRO SATO, and NAOKI ITOH (Sophia University, Tokyo, Japan) *Astrophysical Journal, Part 1* (ISSN 0004-637X), vol. 392, no. 2, June 20, 1992, p. 628-636. refs
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Simulations are conducted of the evolution pulsars on the assumption that they evolve by emitting magnetic dipole radiation and have magnetic fields decaying according to the power law with index of $-1/4$. Simulations are also conducted on the assumption that the pulsars retain constant magnetic fields. Monte Carlo techniques are used to generate sample pulsars of particular distributions of initial periods, period derivatives, magnetic dipole moments, luminosities, and Galactic positions. The period-dependent beaming fraction of pulsars is considered in the simulation. Known selection effects which affect the actual observation are taken into account as accurately as possible. Then best fits are found by comparing the result of the simulation with the observed data of the pulsars. The constant magnetic field model can account for the observed data comparatively well, and the power-law decay model with index of $-1/4$ does considerably less satisfactorily. Author

A92-43753

THE OUTFLOW IN THE L1157 DARK CLOUD - EVIDENCE FOR SHOCK HEATING OF THE INTERACTING GAS

T. UMEMOTO (Nobeyama Radio Observatory, Minamimaki, Japan), T. IWATA (Communications Research Laboratory, Kashima, Japan), Y. FUKUI, H. MIKAMI, S. YAMAMOTO (Nagoya University, Japan), O. KAMEYA, and N. HIRANO (Nobeyama Radio Observatory, Minamimaki, Japan) *Astrophysical Journal, Part 2 - Letters* (ISSN 0004-637X), vol. 392, no. 2, June 20, 1992, p. L83-L86. Research supported by Japan Society for the Promotion of Science. refs
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In the L1157 dark cloud, a well-collimated bipolar CO outflow associated with a cold IRAS source 20386 + 6751 was discovered. The gas temperature toward the blue lobe of the outflow rises to about 30 K from the temperature of the surrounding gas (not greater than 10 K); this high temperature region is very localized within the blue lobe. The HCO(+), HCN, and NH₃ lines show blueshifted and broad-line profiles toward the blue CO lobe. Furthermore, their distributions are similar to that of the blue lobe. Analysis of the energy of the outflow and dense gas suggests that a strong shock caused by the outflow is responsible for the temperature enhancement. Such shock heating has rarely been observed in low-mass star-forming regions. These data show that the outflow has an influence on the thermal properties of the parent cloud at least locally through shock processes in its early evolutionary stage. Author

A92-43754

DETECTION OF SIO EMISSION IN THE L1157 DARK CLOUD

HITOMI MIKAMI (Nagoya University, Japan), TOMOFUMI

UMEMOTO (Nobeyama Radio Observatory, Minamimaki, Japan), SATOSHI YAMAMOTO (Nagoya University, Japan), and SHUJI SAITO (Institute for Molecular Science, Okazaki, Japan) *Astrophysical Journal, Part 2 - Letters* (ISSN 0004-637X), vol. 392, no. 2, June 20, 1992, p. L87-L90. refs
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Intense thermal emission lines of SiO ($v = 0$, $J = 1-0$ and $2-1$) are detected in a low-mass star-forming region, L1157. The emission is confined to a compact region toward the blue lobe of the CO outflow, where shock heating due to interaction between the outflow and dense gas has been found. In contrast, the emission of SiO is not detected toward the IRAS source and the red lobe. The distribution of SiO is different from that of CS; the intense CS line is observed in the vicinity of the IRAS source. The peak fractional abundance of SiO is estimated to be about $10 \exp -7$. This value is higher than a typical upper limit in quiescent dark clouds by a factor of about 10,000. These results suggest that SiO is produced in the shocked region probably through grain destruction processes. Author

A92-43801

STATISTICAL PROPERTIES OF GRAVITATIONAL LENSES WITH A NONZERO COSMOLOGICAL CONSTANT

M. FUKUGITA (Kyoto University, Japan; Cambridge University Institute of Astronomy, England), T. FUTAMASE, M. KASAI (Hiroshima University, Japan), and E. L. TURNER (Princeton University Observatory, NJ; National Astronomical Observatory, Mitaka, Japan) *Astrophysical Journal, Part 1* (ISSN 0004-637X), vol. 393, no. 1, July 1, 1992, p. 3-21. refs
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The effect of a nonzero cosmological constant on gravitational lensing is examined. For high-redshift lens-quasar systems, the uncertainty associated with the distance formulation for the prediction of optical depth of lenses is substantial enough to make discrimination between low and high density universe models difficult. But the cosmological constant increases optical depth greatly, and therefore the lensing frequency provides a simple test for the cosmological constant. For a low-redshift system cosmological models can probably be discriminated by the optical depth given large, homogeneous lens samples. An estimate is made of selection effects and corrections to the model in order to predict lensing frequencies for a realistic case. The provisional conclusion is that a very large cosmological constant (e.g. larger than about 0.95 in the flat geometry) is excluded. The effect of gravitational lensing with a cosmological constant on the quasar-galaxy correlation and on fluctuations in the cosmic background radiation is also studied and found to be insignificant. A.F.S.

A92-45691

LATE DETONATION MODELS FOR THE TYPE IA SUPERNOVAE SN 1991T AND SN 1990N

HITOSHI YAMAOKA, KEN'ICHI NOMOTO (Tokyo, University, Japan), TOSHIKAZU SHIGEYAMA (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Federal Republic of Germany; Tokyo, University, Japan), and FRIEDRICH-KARL THIELEMANN (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA) *Astrophysical Journal, Part 2 - Letters* (ISSN 0004-637X), vol. 393, no. 2, July 10, 1992, p. L55-L58. refs
(Contract MOESC-02302024; MOESC-03218202; NSF AST-89-13799)
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Hydrodynamical models of exploding white dwarfs are presented to account for the newly observed premaximum features of type Ia supernovae 1990N and 1991T in a unified manner. In these models, a carbon deflagration, producing a central Fe/Co/Ni core and an intermediate Si/S/Ca layer, is later transformed into a detonation in the outermost layer. Depending on the transition density, the nucleosynthesis in such late detonations results in the formation of Fe-dominated surface layers or Si/Fe-rich surface layers, which are qualitatively consistent with the inferred composition of SN 1991T and 1990N, respectively. Author

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A92-45895

GIANT MOLECULAR CLOUD FORMATION THROUGH THE PARKER INSTABILITY IN A SKEWED MAGNETIC FIELD

TOMOYUKI HANAWA (Nagoya University, Japan), RYOJI MATSUMOTO (Chiba University, Japan), and KAZUNARI SHIBATA (National Astronomical Observatory, Mitaka, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 393, no. 2, July 10, 1992, p. L71-L74. refs
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The effect of the magnetic skew on the Parker instability is investigated by means of the linear stability analysis for a gravitationally stratified gas layer permeated by a horizontal magnetic field. When the magnetic field is skewed (i.e., the field line direction is a function of the height), the wavelength of the most unstable mode is λ of about $10 H$ where H is the pressure scale height. The growth rate of the short-wavelength modes is greatly reduced when the gradient in the magnetic field direction exceeds $0.5 \text{ rad/scale height}$. These results indicate that the Parker instability in a skewed magnetic field preferentially forms large-scale structures like giant molecular clouds. Author

A92-45898* National Aeronautics and Space Administration, Washington, DC.

QUENCHED CARBONACEOUS COMPOSITE - FLUORESCENCE SPECTRUM COMPARED TO THE EXTENDED RED EMISSION OBSERVED IN REFLECTION NEBULAE

AKIRA SAKATA, SETSUKO WADA, TAKATOSHI NARISAWA, YOICHI ASANO, YUTAKA IJIMA (University of Electro-Communications, Chofu, Japan), TAKASHI ONAKA (Tokyo University, Japan), and ALAN T. TOKUNAGA (Hawaii University, Honolulu) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 393, no. 2, July 10, 1992, p. L83-L86. refs
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The photoluminescence (fluorescence) of a film of the laboratory-synthesized quenched carbonaceous composite (filmy QCC) is shown to have a single broad emission feature with a peak wavelength that varies from 670 to 725 nm, and coincides with that of the extended red emission observed in reflection nebulae. The rapid decay of the filmy QCC red fluorescence in air and of the stable blue fluorescence of the filmy QCC dissolved in liquid Freon suggests that the red fluorescence originates from the interaction of active chemical species and aromatic components in the filmy QCC. A material similar in nature to that of the filmy QCC may be a major component of interstellar dust. Author

A92-46392

THE GRAVITY-DARKENING OF HIGHLY DISTORTED STARS IN CLOSE BINARY SYSTEMS. VIII - PRACTICAL ANALYSIS OF PRIMARY COMPONENTS FILLING THE CRITICAL ROCHE LOBE IN SEMI-DETACHED SYSTEMS OF REVERSE ALGOL-TYPE

YASUHIRO NAKAMURA (Fukushima University, Japan) and MASATOSHI KITAMURA (National Astronomical Observatory of Japan, Mitaka) *Astrophysics and Space Science* (ISSN 0004-640X), vol. 191, no. 2, May 1992, p. 267-282. refs
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A92-46702

BLACK HOLE ACCRETION DISKS EXHIBITING SUPERHUMPS

SHIN MINESHIGE (Ibaraki University, Mito, Japan), MASAHITO HIROSE, and YOJI OSAKI (Tokyo University, Japan) *PASJ: Publications of the Astronomical Society of Japan* (ISSN 0004-6264), vol. 44, no. 2, 1992, p. L15-L18. Research supported by Itoh Science Foundations. refs
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Two independent methods to derive the lower limits to the mass of a compact star in a cataclysmic system are introduced. If the superhumps in cataclysmic variables and in X-ray novae are of a common origin, the same methods can also be used in the case of X-ray sources. The methods are used to estimate the

masses of the compact components in GS 2000 + 25 and GS 1124 - 68 at larger than 3.5 solar masses. C.D.

A92-46704

THE HERBIG BE/AE STAR MWC 1080 AND ITS ASSOCIATED MOLECULAR CLOUD. II - OPTICAL SPECTROSCOPIC OBSERVATIONS

SHIGEOMI YOSHIDA (Kiso Observatory, Nagano, Japan), TOMOKAZU KOGURE (Kyoto University, Japan), MAKOTO NAKANO (Ohita University, Japan), KEN'ICHI TATEMATSU (Nobeyama Radio Observatory, Minamimaki, Japan), and SUHARDJA D. WIRAMIHARDJA (Bosscha Observatory, Bandung Institute of Technology, Lembang, Indonesia) *PASJ: Publications of the Astronomical Society of Japan* (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 77-89. refs
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Molecular lines and optical observations are carried out for the Herbig Be/Ae star MWC 1080, its nearby nebula, and the surrounding molecular cloud. In this paper, the results of optical spectroscopic observations are presented. Long-slit spectra with dispersions of 237 and 116 Å/mm are obtained. The spectra of MWC 1080 were used to classify the spectral type as being early A with a luminosity class of Ib-II. The Balmer-series lines show prominent P Cygni profiles up to H-epsilon. From these profiles, the mass-loss rate due to the stellar wind is roughly estimated to be $10 \exp -6 \text{ solar mass/yr}$; the maximum velocity of the wind reaches up to 1000 km/s. This stellar wind may be responsible for the mechanism that drives the molecular outflow and forms the cavity in the molecular disk. Nebular spectra show no evidence of shock or UV excitation, indicating a pure reflective origin of the nebula. Author

A92-46705

SPECTROSCOPIC OBSERVATIONS OF EMISSION-LINE STARS IN THE ORION. I - ORI OB 1B REGION

TOMOKAZU KOGURE (Kyoto University, Japan), KATSUO OGURA (Kokugakuin University, Tokyo, Japan), MAKOTO NAKANO (Oita University, Japan), and SHIGEOMI YOSHIDA (Kiso Observatory, Nagano, Japan) *PASJ: Publications of the Astronomical Society of Japan* (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 91-99. refs
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The results of spectroscopic observations for 34 emission-line stars (ELs) detected in the Orion Belt (Ori OB 1b) region are presented. Spectral classification and measurements of the H-alpha and H-beta emission intensities are carried out, and their spectral behaviors are compared with those of classical and weak-emission-line T Tauri stars. It is then found that the observed ELs are highly probably T Tauri-type stars in most cases. Author

A92-46706

COUPLING COEFFICIENTS OF PULSATION FOR RADIATIVE STELLAR MODELS

MINE TAKEUTI, FUSATOSHI YAMAKAWA, and TOSHIHITO ISHIDA (Tohoku University, Sendai, Japan) *PASJ: Publications of the Astronomical Society of Japan* (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 101-107. refs
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The second-order theory of coupling is discussed regarding the radial pulsation of radiative stellar models, while taking nonadiabatic effects into consideration. Numerical values are given for model classical cepheids. Adiabatic coupling coefficients are changed slightly when convection is ignored. The entropy changes near the stellar surface increase the strength of coupling. Author

A92-46707

EQUIVALENT WIDTH OF CYCLOTRON LINES IN GAMMA-RAY BURST SPECTRA

OSAMU NISHIMURA and TOSHIKAZU EBISUZAKI (Tokyo University, Japan) *PASJ: Publications of the Astronomical Society of Japan* (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 109-115.

Research supported by Institute of Space and Astronautical Science. refs

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Multiangle radiative transfer problems of a plasma slab with a strong magnetic field illuminated from below by incident gamma-ray radiation are solved. Equivalent widths of the first- and second-harmonic cyclotron lines are obtained. Good agreement is found with previous calculations by Nishimura (1991) and Wang et al. (1989) when the Thomson optical depth is smaller than 7.59×10^{-4} , except that the equivalent width of the first harmonic line is smaller by a factor of 3-30 than that of the second harmonic line in the case of large optical depth and small zenith angle. The discrepancy is explained by the effect of a Lorentzian wing due to the natural linewidth included in the calculation. C.D.

A92-46708

ON X-RAY LUMINOSITIES OF THE QUIESCENT X-RAY NOVAE - GS 2000 + 25 AND GS 2023 + 338

SHIN MINESHIGE (Ibaraki University, Mito, Japan; Cambridge University Institute of Astronomy, England), KEN EBISAWA, MAMORU TAKIZAWA, YASUO TANAKA (Institute of Space and Astronautical Science, Sagami-hara, Japan), KIYOSHI HAYASHIDA, SHUNJI KITAMOTO, SIGENORI MIYAMOTO, and KENTARO TERADA (Osaka University, Toyonaka, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 117-123. Research supported by SERC and Itoh Science Foundations. refs

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X-ray scan observations of the X-ray novae GS 2000 + 25 and GS 2023 + 338 during quiescence are presented. The upper limit to the soft and hard X-ray luminosity of the quiescent GS 2000 + 25 is found to be $(3-9) \times 10^{33}$ erg/s. For such X-ray illumination the thermal instability of the disk cannot be suppressed, whereas the mass overflow instability of the companion star is hard to trigger. An X-ray source with an X-ray intensity of about 10^{34} erg/s at a distance of 0.1 arc deg from GS 2023 + 338 after eruption is found. If this X-ray source is GS 2023 + 338 itself, the estimated X-ray luminosity could be consistent with the mass-overflow instability model. If not, nothing definite can be concluded concerning this model. In any case, X-rays are still too weak to suppress the thermal instability of the disk. C.D.

A92-46709

A CHLORINE-COBALT PECULIAR STAR HR 1094

KOZO SADAKANE (Osaka Kyoiki University, Kashiwara, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 125-133. refs

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The abundances of 11 elements and the upper limits of three other elements in a peculiar B-type star, HR 1094, have been determined. This star exhibits unusually strong lines of Cl II and Co II. These elements were found to be overabundant by 3.8 dex and 3.3 dex, respectively. The abundances of Ti, Cr, Fe, Sr, Pt, and Hg are enhanced while those of Sc and Ni are not. Several light metals, Mg, Si, and Ca, were found to be underabundant. The abundance pattern found in HR 1094 is quite unique among B-type CP stars, showing the composite abundance characteristics of both Hg-Mn stars and magnetic stars. Author

A92-46711

ON A HERMITE INTEGRATOR WITH AHMAD-COHEN SCHEME FOR GRAVITATIONAL MANY-BODY PROBLEMS

JUNICHIRO MAKINO (Tokyo, University, Japan) and SVERRE J. AARSETH (Cambridge University Institute of Astronomy, England) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 141-151. refs

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HACS, a fourth-order Hermite integrator with the Ahmad-Cohen scheme is implemented. HACS is self-starting, so its implementation

is considerably simpler than the original ACS. Compared to ACS, HACS allows time steps twice as long for the same accuracy and the increase in calculation cost per timestep is not very large. The actual gain in speed depends on the hardware and ranges between a factor of one and two. The gain using ACS would be significantly smaller on vector or parallel machines. C.D.

A92-46712

ON REGULATION OF THE JET SPEED IN SS 433

JUN FUKUE (Osaka Kyoiku University, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 153, 154. refs

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The speed of SS 433 jets has been observed to be temporally constant. It is proposed that this constancy is regulated by a pair creation process in which the temperature reaches its maximum. When the energy input at the base of the jet increases, the additional energy is consumed so as to produce particles while the temperature maintains a maximum value. Thus the jet speed, which is supposed to be attained by the conversions of thermal energy, does not change. If the jet emanates from the two-temperature pair atmosphere near $5r_g$, the jet would have a terminal speed of $0.2c$ according to the hydrodynamical picture. Author

A92-46714

TIME-GEOSTATIONARY ORBITS IN THE SOLAR SYSTEM

MIZUHIKO HOSOKAWA (Communications Research Laboratory, Kobe, Japan) and FUJINOBU TAKAHASHI (Communications Research Laboratory, Koganei, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 159-162. refs

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According to general relativity, each object has its own proper time. It is shown here that, in the solar system, there are three free-fall circular orbits that possess the same proper time as that on the geoid surface. These are the orbits around the earth, the sun, and Jupiter. These orbits are called 'time-geostationary orbits'. In the future space age these orbits will play important roles in establishing interplanetary time standards and in allowing highly accurate astronomical measurements. Author

A92-46715

ICE-SKATER MODEL FOR THE NUCLEUS OF COMET LEVY 1990C - SPIN-UP BY A SHRINKING NUCLEUS

JUN-ICHI WATANABE (National Astronomical Observatory, Mitaka, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 163-166. refs

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The activity period of Comet Levy 1990c diminished by about 10 percent during a period of about one half month. This suggests a gradual increase in the angular velocity of the rotating nucleus. The ice-skater model is proposed for this spin-up phenomenon as a result of a shrinking of the nucleus. Nucleus shrinking along with the formation of a dense mantle changes the moments of inertia of the nucleus, and produces a spin-up of the rotation. The observed mass-loss rate indicates an extremely low density (not greater than 0.14 g/cm^3), which suggests that primitive comets have a porous amorphous ice surface. Author

A92-47136

ULTRAVIOLET EXCITATION OF H2 EMISSION IN STARBURST GALAXIES?

HIDEAKI MOURI (Meteorological Research Institute, Tsukuba, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 257, no. 3, Aug. 1, 1992, p. 433-437. refs

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The generation of H2 line emission by UV photons from massive stars is modeled. The models are used to reconsider the H2 properties of starburst galaxies, previously explained by shock excitation of H2. It is shown that UV excitation of H2 can explain the correlation between H2 2.12-microns and forbidden Fe II 1.64-micron emission lines, which has been cited as evidence for

shock excitation. Moreover, in the case of M82, the amount of molecular material heated by UV radiation is found to be sufficient to account for the observed H₂ luminosity. Hence UV heating of molecular clouds is one of the most plausible excitation mechanisms of H₂ emission in starburst galaxies. Author

A92-47140

ON THE CORES OF COLLISIONLESS SELF-GRAVITATING SYSTEMS

TOSHIYA NOZAKURA (Hokkaido University, Sapporo, Japan) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 257, no. 3, Aug. 1, 1992, p. 455-462. refs
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A hypothesis is tested that 'the core produced through N-body simulation of a collisionless self-gravitating system is the lowest energy state accessible from the given initial configuration under the constraint of incompressible redistribution of phase-space density'. Lowest energy states for Van Albada's uniform initial configurations are constructed and compared with simulation results. Although there are quantitatively large differences, some qualitative similarities exist in the one-particle energy distribution function and the density profile. This fact indicates that the hypothesis holds but rather incompletely for 3D cases, which makes a striking contrast to 1D cases where it seems to hold fairly well. It is also found that the theory of Wiechen et al. (1988), for predicting the final state of violent relaxation, is not useful, at least for the core parts of N-body simulations. Author

A92-47142* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

A SEARCH FOR THE IRON ABSORPTION EDGE IN THE TAIL OF AN X-RAY BURST FROM X1636 - 53

C. S. R. DAY (Institute of Space and Astronautical Science, Sagami-hara, Japan; NASA, Goddard Space Flight Center, Greenbelt, MD), A. C. FABIAN (Cambridge University Institute of Astronomy, England), and R. R. ROSS (Cambridge University Institute of Astronomy, England; College of the Holy Cross, Worcester, MA) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 257, no. 3, Aug. 1, 1992, p. 471-475. Research supported by Japan Society for the Promotion of Science, Royal Society, and College of the Holy Cross. refs
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Model atmosphere calculations of the spectrum of a neutron star cooling after an X-ray burst show that the photoelectric edge of iron should be prominent. No clear evidence for such a redshifted feature in the spectrum of a burst from X1636 - 53 is found, and it is concluded that the iron abundance there must be less than 0.3 solar. Unless the iron abundance of the surface matter on the neutron star is highly time-dependent, the present result argues against the 4.1-keV absorption line seen in some bursts from X1636 - 53 by Waki et al. (1984) being due to iron. The iron edge will be a powerful diagnostic of the surface redshift of the neutron star in burst sources where the iron abundance is more nearly solar. Author

A92-48106

ON DISTANCES AND THE HUBBLE PARAMETER DETERMINATION IN GRAVITATIONAL LENSES

KAZUYA WATANABE, MISAO SASAKI, and KENJI TOMITA (Kyoto University, Uji, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 394, no. 1, July 20, 1992, p. 38-50. refs
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Fundamental unsolved problems concerning the gravitational lens effect are discussed on the basis of relativistic optical equations. There are two aspects of the gravitational lens effect, namely, the image deformation and time delay and the apparent amplification of the luminosity of distant sources. The validity of the previous approaches to these aspects and the importance of shear in the cosmological distance are investigated in a simplified model universe. The possibility of the gravitational lens effect as a 'cosmological telescope' to determine the Hubble parameter is also investigated. Author

A92-48108

HUBBLE FLOWS IN THE PISCES-PERSEUS REGION FROM THE GIOVANELLI-HAYNES GALAXY SAMPLE

T. ICHIKAWA (Kiso Observatory, Nagano; Hitotsubashi University, Kunitachi, Japan) and M. FUKUGITA (Kyoto University, Japan; Cambridge University Institute of Astronomy, England) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 394, no. 1, July 20, 1992, p. 61-80. refs
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Results are presented of an analysis made of the Hubble flow for galaxies in the Pisces-Perseus supercluster region using the Tully-Fisher (TF) relation in the B band, applied to the sample of Giovanelli and Haynes (1985). Various statistical errors caused by the dispersion of TF relations, observational selection effects, and an inhomogeneous spatial distribution of galaxies are examined on the basis of a data set containing 1119 galaxies. Full control over the Malmquist bias was found to be essential in deriving the result. The recession of galaxies is described well by a universal Hubble constant for all galaxies up to a redshift of 10,000-15,000 km/s, with the exception of those located within 2000 km/s, for which the sample is clearly affected by an inflow. Full consistency was found with the H-band TF analysis of Aaronson et al. (1980, 1982, 1986) for their galaxy sample. C.A.B.

A92-48328

MAGNETIC FIELDS IN SPIRAL GALAXIES

MASASHI CHIBA Astronomical Herald (ISSN 0734-2466), vol. 85, no. 6, 1992, p. 246-251. In Japanese.
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The magnetic-field characteristics in spiral galaxies are investigated, with emphasis on the Milky Way. The dynamo theory is considered, and axisymmetric spiral (ASS) and bisymmetric spiral (BSS) magnetic fields are analyzed. Toroidal and poloidal magnetic fields are discussed. Y.P.Q.

A92-49403

DENSITY PERTURBATIONS DRIVEN BY THE IRREGULAR SPATIAL CURVATURE IN INHOMOGENEOUS COSMOLOGICAL MODELS

KENJI TOMITA (Kyoto University, Uji, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 394, no. 2, Aug. 1, 1992, p. 401-408. refs
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The behaviors of inhomogeneities in the realistic universe are often described using an approximate model consisting of a homogeneous model plus its perturbations. There is a possibility, however, that true inhomogeneities include perturbations in a mode different from the above perturbations. In this paper it is shown that the density perturbations driven by the irregular spatial curvature are in such an independent mode. The growth factor of the latter perturbations is a square of that in the usual linear adiabatic perturbation, and so, if the perturbations of this mode are dominant, they will have important influences upon the problem of structure formation. Author

A92-49416

MAPPING OBSERVATIONS OF SULFUR-CONTAINING CARBON-CHAIN MOLECULES IN TAURUS MOLECULAR CLOUD 1 (TMC-1)

YASUHIRO HIRAHARA (Tokyo, University, Japan), HIROKO SUZUKI (Nobeyama Radio Observatory, Minamimaki, Japan), SATOSHI YAMAMOTO (Nagoya University, Japan), KENTAROU KAWAGUCHI (Nobeyama Radio Observatory, Minamimaki, Japan), NORIO KAIFU (National Astronomy Observatory, Mitaka, Japan), MASATOSHI OHISHI (Nobeyama Radio Observatory, Minamimaki, Japan), SHURO TAKANO (Nobeyama Radio Observatory, Minamimaki; Institute for Molecular Science, Okazaki, Japan), SHIN-ICHI ISHIKAWA (Nobeyama Radio Observatory, Minamimaki, Japan), and AKIMASA MASUDA (Tokyo, University, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 394, no. 2, Aug. 1, 1992, p. 539-551. Research supported by Japan Society for the Promotion of Science. refs
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High-resolution mapping observations of TMC-1 using the lines of CCS, C3S, C(S-32), and C(S-34) molecules are reported. The source was also observed at HC3N, HC5N, NH3, C4H, and HCS(+) lines with high signal resolution for a systematic comparison with sulfur-containing carbon-chain molecules. Accurate molecular distributions are derived, and the origin of chemical differences in TMC-1 are discussed with reference to recent observations of dark cloud cores and chemical model calculations. V.L.

A92-49425

DISCOVERY AND X-RAY PROPERTIES OF GS 1124 - 683 (= NOVA MUSCAE)

SHUNJI KITAMOTO, HIROSHI TSUNEMI, SIGENORI MIYAMOTO, and KIYOSHI HAYASHIDA (Osaka University, Toyonaka, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 394, no. 2, Aug. 1, 1992, p. 609-614. refs

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The intensity and spectral evolution of the bright X-ray nova GS 1124 - 683, observed with the All Sky Monitor from January 5 to the end of August, 1991, are presented. The spectra are roughly represented by a two-component model consisting of a power law and a thermal (disk-blackbody or blackbody) component. In its rising stage, the power-law component was dominant, and the thermal component gradually increased with temperature and emission area. In the decay phase, the power-law component decreased rapidly, whereas the thermal component decayed exponentially with a time constant of 31.2 ± 0.1 days. Some implications of the accretion phenomenon during the X-ray nova activity are discussed. V.L.

A92-49440

LIGHT-CURVE ANALYSIS OF CLASSICAL NOVAE

MARIKO KATO (Keio University, Yokohama, Japan; Illinois, University, Urbana) and ICKO IBEN, JR. (Illinois, University, Urbana) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 394, no. 2, Aug. 1, 1992, p. L47-L51. refs

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Theoretical visual and UV light curves for the decay phase of classical novae are presented and compared with observations for Nova Cyg 1978. Using optically thick wind theory, sequences are derived of models consisting of a white dwarf of mass 1.2, 1.0, and 0.8 solar masses and an envelope of uniform chemical composition through which a steady wind flows. It is shown how estimates of white dwarf mass and distance can be achieved by comparing the characteristics of nova outbursts with the characteristics predicted by optically thick wind theory. I.S.

A92-49732

A STUDY OF INCLINATION EFFECTS ON GALAXY SURFACE BRIGHTNESS

KEIICHI KODAIRA (National Astronomical Observatory, Mitaka, Japan), MAMORU DOI, and KAZUHIRO SHIMASAKU (Tokyo, University, Japan) *Astronomical Journal* (ISSN 0004-6256), vol. 104, no. 2, Aug. 1992, p. 569-577. refs

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The V-band data obtained with the KISO Schmidt telescope are used to investigate the inclination effects due to the internal absorption on the surface brightness of spiral galaxies at the center μ_0 and at the equivalent radius $\mu(e)$. The results confirm the general trend of the inclination effect from the ESO Schmidt data in the B band, in particular, the small inclination effect on $\mu(e)$ from middle-type spirals, upon which the current argument of the highly opaque nature of galaxy disks by Valentijn (1991) is based. Those empirical results are compared with predictions from simple models of disks and bulges obscured by an exponential absorbing layer with various optical thicknesses and relative scale height. The general trends of variation in $\mu(e)$ and μ_0 over various types of spiral galaxies are interpreted in terms of increasing bulge/disk ratio, and of decreasing relative scale height with decreasing type index, without assuming highly opaque disks. C.A.B.

A92-52314* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

GINGA OBSERVATIONS OF CENTAURUS X-3

F. NAGASE, R. H. D. CORBET (Institute of Space and Astronautical Science, Sagami-hara, Japan), C. S. R. DAY (Institute of Space and Astronautical Science, Sagami-hara, Japan; NASA, Goddard Space Flight Center, Greenbelt, MD), H. INOUE, T. TAKESHIMA, K. YOSHIDA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and T. MIHARA (Tokyo, University, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 396, no. 1, Sept. 1, 1992, p. 147-160. Research supported by Royal Society and Japan Society for the Promotion of Science. refs

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Attention is given to a series of observations of Centaurus X-3 made with Ginga on March 22-24, 1989, over a complete orbital cycle. The data set includes a pre-eclipse dip, the eclipse ingress and egress, the eclipse itself, and a phase of high steady emission after egress. The mid-eclipse ephemeris obtained yields an estimate of the rate of change of the orbital period of $-(1.738 \pm 0.004) \times 10^{-6}$ yr, confirming the rate of change reported by Kelley et al. (1983) and improving the precision by a factor of 20. The pulse profiles obtained with Ginga during the high post-egress phase are double-peaked at low energies, and show a reversal of phase of 180 deg. No pulsations are detected during the eclipse and at low energies during the pre-eclipse dip, indicating that X-ray emission at these phases is due to scattering by extended matter. The energy of the iron emission line varies between 6.5 and 6.7 keV during the observation, while its equivalent width varies between 0.18 and 1.5 keV. C.A.B.

A92-52343

DETECTION OF HNCCC IN TMC-1

KENTAROU KAWAGUCHI, SHURO TAKANO, MASATOSHI OHISHI, SHIN-ICHI ISHIKAWA, KEISUKE MIYAZAWA (Nobeyama Radio Observatory, Minamimaki, Japan), NORIO KAIFU (National Astronomical Observatory, Mitaka, Japan), KOICHI YAMASHITA (Institute for Fundamental Chemistry, Kyoto, Japan), SATOSHI YAMAMOTO, SHUJI SAITO (Nagoya University, Japan), YASUHIRO OHSHIMA (Tokyo, University, Japan) et al. *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 396, no. 1, Sept. 1, 1992, p. L49-L51. Research supported by MOESC. refs

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The study identifies the HNCCC molecule, an isomer of cyanoacetylene HCCCN, in TMC-1 through observations with the Nobeyama 45-m telescope, considering the observed spectral pattern and results of ab initio calculations and laboratory microwave spectroscopy. The column density of HNCCC in TMC-1 is determined to be $3.8(0.6) \times 10^{11}$ / sq cm, which is 160-450 times smaller than that of HCCCN. C.A.B.

A92-54352

NONLINEAR GRAVITATIONAL EVOLUTION OF PHASES AND AMPLITUDES IN ONE-DIMENSIONAL COSMOLOGICAL DENSITY FIELDS

JIRO SODA (Ehime University, Matsuyama, Japan; Kyoto University, Uji, Japan) and YASUSHI SUTO (Kyoto University, Uji, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 396, no. 2, Sept. 10, 1992, p. 379-394. Research supported by Japan Society for the Promotion of Science. refs

(Contract MOESC-02952045)

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Nonlinear evolution of density fluctuations is examined using the Zel'dovich solution in a one-dimensional cosmological field. In particular, the distributions of phases and amplitudes of density fluctuations in Fourier space are studied in detail. The higher frequency modes generated from the pre-existing modes in the lower frequencies show some systematic phase correlation among different wavenumbers. A conservation law of fluctuation power is discovered, which holds for the power-transfer due to the nonlinear mode-coupling in a one-dimensional gravitational density field; the transfer of power tends to occur in the direction to achieve the equipartition of fluctuation power per unit wavenumber. This

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tendency is not only limited to a one-dimensional system, but rather seems to be quite generic from the available indications from the analysis of three-dimensional cosmological systems.

Author

A92-54353

PROPERTIES OF GALACTIC HALOS IN SPATIALLY FLAT UNIVERSES DOMINATED BY COLD DARK MATTER - EFFECTS OF NONVANISHING COSMOLOGICAL CONSTANT

TATSUSHI SUGINOHARA (Tokyo, University, Japan) and YASUSHI SUTO (Kyoto University, Uji, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 396, no. 2, Sept. 10, 1992, p. 395-410. Research supported by MOESC. refs

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Properties of galactic halos in the cold dark matter (CDM) dominated universes are studied using cosmological N-body simulations. Assuming that the universe is spatially flat, two specific examples in CDM cosmogonies are considered; one is the Einstein-de Sitter model, and the other is given a low mean mass density and nonvanishing cosmological constant, λ . It is found that flat rotation curve of halos extending about 100/h kpc is reproduced only with the fixed-linking friends-of-friends algorithm for the CDM models in the Einstein-de Sitter universe. Thus such a shape of the rotation curve may not be a universal feature intrinsic to the models. Models with nonzero λ , on the other hand, show nearly flat rotation curves up to about (50-100)/h kpc. In addition, this conclusion is relatively insensitive to the halo identification algorithm in contrast to the case with the Einstein-de Sitter models. Therefore nonzero λ CDM models most successfully account for the observed flat rotation curve of galaxies.

Author

A92-54384

GRAVITATIONAL WAVE BURST PRODUCED BY MERGING OF CENTRAL BLACK HOLES OF GALAXIES

TOSHIYUKI FUKUSHIGE, TOSHIKAZU EBISUZAKI, and JUNICHIRO MAKINO (Tokyo, University, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 396, no. 2, Sept. 10, 1992, p. L61-L63. refs

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When galaxies merge, the central black holes rapidly sink toward the center of the system and make a binary. It is found that this black hole binary merges within less than or approximately equal to 10 exp 9 yr. This merging of black holes produces an intense burst of the gravitational wave. The nature of these gravitational wave bursts, is investigated, and it is found that the dimensionless amplitude at the earth is as high as 10 exp -15 if black holes with masses of 10 exp 8 solar masses merge at the distance of 2 Gpc. The mean time between bursts is about 2 yr if the elliptical galaxies are the merger remnants of galaxies having central black holes. It is found that dynamical friction makes the orbit highly eccentric. The lifetime of a binary with a highly eccentric orbit is much shorter than that of a binary with a circular orbit, because the emission of the gravitational wave is much stronger for shorter periastron distance.

Author

A92-54390

ON THE DETECTABILITY OF THE GAS OF OTHER SOLAR NEBULAE

TOSHIHIRO OMODAKA, YOSHIMI KITAMURA (Kagoshima University, Japan), and EIKO KAWAZOE (Ibaraki University, Mito, Japan) *Astrophysical Journal*, Part 2 - Letters (ISSN 0004-637X), vol. 396, no. 2, Sept. 10, 1992, p. L87-L90. refs

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Velocity profiles of the (C-12)O(J = 1-0) and (C-13)O(J = 1-0) lines emitted from the solar nebula are numerically calculated by taking account of the radiative transfer of the lines. For the solar nebula the two theoretical models of a low-mass nebula and a high-mass nebula are adopted. It is shown that the calculated profiles typically have double peaks at the velocities of +/- 2-5 km/s, which are separable from ambient emission, and that the profiles vary greatly depending on the inclination angle between the rotation axis of the nebula and the line of sight. The peak flux

densities of the profiles are converted into the antenna temperatures of 0.005 to 0.15 K for T Tauri stars in the Taurus complex (140 pc). It is concluded that the gas of other solar nebulae with the radius of about 100 AU can be detected by radio observations of the CO lines until the gas dissipates.

Author

A92-54576

FEEDING OF INTERGALACTIC GAS CLOUDS ONTO ELLIPTICAL GALAXIES

YOSHIKAKI SOFUE (Tokyo, University, Mitaka, Japan) and KEN-ICHI WAKAMATSU (Gifu University, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 44, no. 3, 1992, p. L23-L26. refs

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A case involving elliptical galaxies which are imbedded in extended hot gaseous halos, which extend to radii much larger than the galaxies' optical radii, is discussed. The intergalactic H I gas clouds that are flying about an elliptical galaxy are considered. It is shown that these gas clouds are easily captured by elliptical galaxies by ram-pressure accretion due to circumgalactic hot gas.

R.E.P.

A92-54577

RADIAL DISTRIBUTION OF CO IN BARRED SPIRALS AND THE BAR STRUCTURE OF OUR GALAXY

NAOMASA NAKAI (Nobeyama Radio Observatory, Minamimaki, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 44, no. 3, 1992, p. L27-L30. refs

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CO data concerning three barred spiral galaxies, e.g., Maffei 2, NGC 2903, and NGC 253, have been analyzed to obtain the radial distribution of the CO surface density. The radial distribution demonstrates a strong peak at the galactic centers, and a secondary peak at distances of a few kiloparsec from the center, that are very similar to the Galaxy. The numerical simulations and observational results suggest that the Galaxy has a barred shape.

R.E.P.

A92-54578

ELEMENT MIXING IN A STELLAR INTERIOR BY THE BALBUS-HAWLEY MECHANISM

SHOJI KATO (Kyoto University, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 44, no. 3, 1992, p. L31-L33. refs

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It is noted that Balbus and Hawley recently presented evidence for a powerful local instability of differentially rotating magnetic accretion disks. This paper examines the possibility that the process may also resolve the problem of element mixing in stellar interiors. When this possibility is examined, an essential difference is emphasized from the case of accretion disks.

R.E.P.

A92-54580

THREE-DIMENSIONAL MHD SIMULATION OF THE PARKER INSTABILITY IN GALACTIC GAS DISKS AND THE SOLAR ATMOSPHERE

RYOJI MATSUMOTO (Chiba University, Japan) and KAZUNARI SHIBATA (National Astronomical Observatory, Mitaka, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 167-175. refs

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3D magnetohydrodynamic simulations were performed in a study of the nonlinear evolution of the Parker instability in galactic gas disks and/or accretion disks, as well as in emerging flux regions (EFR) of the sun. The initial magnetic fields are parallel to one of the horizontal coordinates in magnetostatic equilibrium. The effect of coupling between the Parker (undular) instability and the interchange instability was studied. In both the galactic and solar cases, adjacent flux tubes move independently, so that a highly interleaved structure is created, although the expansion of magnetic loops induced by the Parker mode is similar to that

found in 2D models. In galactic gas disks magnetic loops evacuate regions of interstellar space by accumulating interstellar gas in magnetic pockets. The accumulated gas is compressed by both infalling gas and horizontally expanding magnetic loops, forming dense, thin spurs. That is, the 3D nonlinear Parker instability creates a large-scale void-shell-spur structure, which is very similar to the large-scale structure of the universe as well as the interstellar gas and/or dust distribution. In the solar EFR model, magnetic loops expand into the corona, while the gas slides down along the magnetic field lines. An approximate self-similar expansion and shock wave formation at the loop footpoints (which were previously found in 2D loops) were observed in 3D loops. A horizontal expansion of the rising flux tubes produces vortex motions, which then generate torsional Alfvén waves. Author

A92-54581

THE EVOLUTION OF A MAGNETIZED SUPERBUBBLE

KOHJI TOMISAKA (Niigata University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 177-191. refs

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Superbubbles expanding in a magnetized interstellar matter were studied using a 2D axisymmetric magnetohydrodynamics code. A superbubble, which is formed by sequential supernova explosions in an OB association, appears to be spherical in its early evolution phase. The hot matter ejected from supernovae is surrounded by a shell, which comprises swept-up interstellar matter and magnetic fields. When the magnetic energy contained in a superbubble becomes nonnegligible, compared with the driving thermal energy, the bubble begins to expand mainly in the direction parallel to the magnetic field. The structure at this stage is much different from that of a nonmagnetic superbubble, e.g., the shell expanding perpendicular to the magnetic field is thick, which is supported by the magnetic field. In a late phase, the expansion perpendicular to the magnetic field stops, and the bubble expands in one dimension. There exists a critical supernova rate above which the superbubble can punch out the galactic gas disk. Author

A92-54582

CRITERIA FOR THE COLLAPSE AND FRAGMENTATION OF ROTATING CLOUDS

SHOKEN M. MIYAMA (National Astronomical Observatory, Mitaka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 193-202. refs

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Three-dimensional computations for the processes of the collapse and fragmentation of rotating gases were performed while assuming a polytropic relation with various values of the adiabatic index (γ). The initial condition of rotating gas is spherical with both uniform rotation and density, including random-density perturbations. By computing the evolution of many initial models it can be empirically determined what model will fragment or not. In order to interpret the numerical results, the flatness of a rotating disk-like core which is formed in a collapsed cloud was studied. Author

A92-54583

GRAVITATIONAL INSTABILITY INDUCED BY A CLOUD-CLOUD COLLISION - THE CASE OF HEAD-ON COLLISIONS BETWEEN CLOUDS WITH DIFFERENT SIZES AND DENSITIES

ASAO HABE and KANJI OHTA (Hokkaido University, Sapporo, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 203-226. refs

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In order to investigate star formation triggered by cloud-cloud collisions, axisymmetric numerical hydrodynamic calculations of supersonic, head-on collisions between nonidentical clouds are performed. Using axisymmetric smoothed particle hydrodynamics, the condition of the gravitational instability of clouds is studied.

Nonidentical cloud-cloud collisions, that is, collisions between clouds with different sizes and densities, are more frequent in interstellar space. It is assumed that a small cloud is denser than a large cloud, and that both small and large clouds are gravitationally stable before collision. Two types of initial cloud models: hydrostatic equilibrium clouds confined by the external pressure and uniform density clouds are examined. Numerical results show that the large cloud is disrupted due to a bow shock induced by the collision, and that the small cloud is compressed by the shock. The self-gravity is enhanced in the postshock gas of the small cloud and a compact clump is tentatively formed. The case in which this clump becomes gravitationally unstable is described. It is found that the initial mass of a small cloud needed to be gravitationally unstable by the nonidentical collisions is well below the Jeans mass of the initial small clouds. In the hydrostatic cloud model, a nonidentical cloud-cloud collision can more easily induce a gravitational instability than in the uniform cloud model. The important role of nonidentical cloud-cloud collisions in burst star formation in galaxies is discussed. Author

A92-54584

A MAGNETOHYDRODYNAMIC MODEL FOR HERBIG-HARO OBJECTS - MAGNETICALLY GUIDED SHOCKED FLOWS ASSOCIATED WITH OPTICAL JETS FROM YOUNG STELLAR OBJECTS

YUTAKA UCHIDA, YASUSHI TODO (Tokyo, University, Japan), ROBERT ROSNER (Chicago, University, IL), and KAZUNARI SHIBATA (Aichi University of Education, Kariya, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 227-243. Research supported by Japan Society for the Promotion of Science and NSF. refs

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An MHD model for Herbig-Haro (HH) objects in which a large-scale interstellar magnetic field plays a basic role is presented. The model contains two essential, distinct elements. First, it is assumed that the large-scale interstellar magnetic field is spatially constricted during the contraction phase of star formation, and becomes helical due to production of a toroidal field component by the rotation of the central star + disk system. Second, it is assumed that this large-scale field acts as a guide field for the high-velocity flows associated with the optical jets emanating from the star forming at the center. In that case, it is shown that the impinging optical jet accompanies four distinct shock fronts, namely, MHD fast and slow shocks ahead, and reverse fast and slow shocks propagating backward into the moving jet medium behind the contact discontinuity. The result of this simplified 1.5-D MHD simulations strongly indicate that this 'magnetically-guided stream' picture can account for the high Doppler and proper-motion velocities of the HH objects, which are generally different from each other. Results suggest that the more complex morphological characteristics of these objects such as the 'jet with bright-spot + bow shock' type structures (e.g., HH34) and those with 'wiggled filamentary structures' (e.g., HH46/47) of some HH objects could be explained by MHD models in 2.5D or 3D. Author

A92-54585

BEHAVIOR OF JETS FROM YOUNG STELLAR OBJECTS IN LARGE-SCALE INTERSTELLAR MAGNETIC FIELDS - MHD MODEL OF HERBIG-HARO OBJECTS IN 2.5-D SIMULATIONS

YASUSHI TODO, YUTAKA UCHIDA (Tokyo, University, Japan), TETSUYA SATO (National Institute for Fusion Science, Nagoya, Japan), and ROBERT ROSNER (Chicago, University, IL) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 245-263. Research supported by Japan Society for the Promotion of Science and NSF. refs

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The results of 2.5-D MHD numerical simulations of the behavior of YSO (young stellar objects) jets - so-called 'optical jets' - in a magnetized interstellar medium are described. The aim is to understand the behavior of such jets under circumstances in which the large-scale interstellar magnetic field is twisted helically by the rotation of the protostar and the protostellar disk through which these fields thread. Herbig-Haro objects are interpreted by a

magnetic model as being the shocked gas caused by the injection of YSO jets into an interstellar medium pervaded by a large-scale helical magnetic field. Results show that the bow shock and the jet-terminal shock are both MHD fast shocks, accompanied by a slow shock, respectively. For weak magnetic fields, the shocked gas expands in the lateral direction and forms a cocoon around the jet by stretching the magnetic field. For strong magnetic fields, fast shocks are either weak or not formed, and the kinetic energy is mainly dissipated at slow shocks. In the presence of strong magnetic fields, the separation between the bow shock and the jet-terminal shock becomes much larger because of the effect of the magnetic pressure; further, Kelvin-Helmholtz instability is entirely suppressed. The cocoon structure in the strong-field case is either very slender, or not formed at all, because the shocked gas cannot expand perpendicular to the magnetic field. Although the weak helical magnetic fields in the ambient medium reduce the propagation velocity of the bow shock, the bow shock can nevertheless propagate faster in magnetic fields exceeding a certain critical value. Author

A92-54588

RAPID ORBITAL DECAY OF A BLACK HOLE BINARY IN MERGING GALAXIES

TOSHIYUKI FUKUSHIGE, TOSHIKAZU EBISUZAKI, and JUNICHIRO MAKINO (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 281-289. refs

(Contract MOESC-02640197; MOESC-02452012)

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Most elliptical galaxies are believed to have massive central black holes. When they merge, their central black holes sink toward the core of the merger and form a binary system. The evolution of such a black hole binary under a uniform distribution of field stars is investigated. It is found that a black hole binary merges in about 10 to the 7th yr. The orbital energy and angular momentum of a black hole binary are transferred to the field stars through dynamic friction. The orbit of the binary becomes highly eccentric, since dynamic friction is most effective at the apocenter with the minimum orbital velocity. The periastron distance decreases exponentially, and eventually the black holes merge when the emission of the gravitational radiation becomes significant. The energy transferred from the binary to the field stars is comparable to the binding energy of the core of the parent galaxy. Author

A92-54589

ENERGY SEGREGATION THROUGH VIOLENT RELAXATION

YOKO FUNATO, JUNICHIRO MAKINO, and TOSHIKAZU EBISUZAKI (Tokyo, University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 291-301. refs

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Numerical N-body simulations of a violent relaxation process using a special-purpose computer, GRAPE-1, are performed. It is found that violent relaxation enhances segregation in energy space. In violent relaxation, particles with higher energy gain more energy than particles with lower energy. In two-body relaxation, however, particles with higher energy lose energy, and particles with lower energy gain it. Therefore, self-gravitating system does not approach thermal equilibrium through violent relaxation. Violent relaxation changes the energies of particles through a time variation of the mean potential field caused by the coherent motion of particles. The change in the kinetic energy does not depend on the energy of the particle, itself, since coherent motion, which has a much larger energy, heats all particles in order to approach energy equipartition, regardless of their velocities. The magnitude of the change in the mean potential field in the outer region is higher than that in the inner region. Therefore, the gain in the average energy in the outer region is larger than that in the inner region. This difference in the energy gain enhances segregation in energy space, since particles with higher energy receive a greater amount of energy. Therefore, violent relaxation does not lead a self-gravitating system to thermal equilibrium. This result implies

that the energy of each particle in a merger remnant is strongly correlated with its initial energy. Therefore, the radial structures of galaxies, such as the color gradient, are likely to survive violent relaxation. Author

A92-54590

HARD X-RAYS FROM THE SUPERNOVA REMNANT IC 443

ZHEN R. WANG, IKUKO ASAOKA, SAITO HAYAKAWA (Nagoya University, Japan), and KATSUJI KOYAMA (Kyoto University, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 303-308. Research supported by NNSFC and Nagoya University. refs

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Hard X-rays with energies of up to 20 keV were observed from IC 443 with the X-ray astronomy satellite Ginga. The X-ray flux at energies below 6 keV was found to be consistent with that seen during earlier observations with the Einstein Observatory and HEAO A-2; the X-ray spectrum was observed to be smoothly extended to 20 keV, in which the hard X-ray part could be fitted with a power law of a photon index of about two. The iron line feature was not conspicuous; the equivalent width for the iron emission line was about 0.25 keV. Although an X-ray emission model of IC 443 cannot be uniquely derived from the observations, it is likely that the hard X-ray are emitted from a shock-heated plasma with a temperature higher than 10 keV and a density smaller than 0.1 atoms cm^{-3} , which is located in the south-western and western regions of IC 443. This model implies that the age of IC 443 is about one thousand years instead of the previous estimate of 10,000 yr. It is suggested that IC 443 is the remnant of a supernova in AD 837. Author

A92-54591

STRENGTH OF THE O I TRIPLET LAMBDA 7771-5 AND ATMOSPHERIC MICROTURBULENCE IN A-F STARS

YOICHI TAKEDA (Tokyo, University, Mitaka, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 309-324. refs

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The behavior of the microturbulence (ξ) in the H-R diagram corresponding to A-F stars is investigated, based on a comparison of the observed and theoretical strengths of the O I triplet lambda 7771-5. The non-LTE effect, which along with ξ significantly affects the strength of this line, was adequately accounted for by applying the results from detailed non-LTE calculations performed on a sufficiently realistic model O I atom. It is seen that for stars of the luminosity classes III-V, there seems to exist a maximum peak of ξ at about late A, which may be related to a convective zone lying near to the photosphere in stars of this spectral type. R.E.P.

A92-54592

FORMATION OF GALACTIC BULGES BY STARBURSTS AND THE ORIGIN OF HUBBLE MORPHOLOGICAL TYPES

YOSHIAKI SOFUE (Tokyo, University, Mitaka, Japan) and ASAO HABE (Hokkaido University, Sapporo, Japan) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 325-329. Research supported by Japan Society for the Promotion of Science. refs

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The possibility that a significant fraction of galactic bulge stars are formed from gas clouds ejected by starbursts in the central regions of galaxies is investigated. Stronger bursts result in greater and more extended bulges, and thereby lead to early type galaxies, and vice versa. As the burst strength depends on the strength of tidal interaction, Hubble types inevitably depend on the galactic number density, which explains the density-morphology relationship. R.E.P.

A92-54593

NOTE ON 5:7 PHASE-LOCKING IN THE TWO-MODE COUPLING OF STELLAR PULSATION

YASUO TANAKA, KEIJI SEYA (Ibaraki University, Mito, Japan), and MINE TAKEUTI (Tohoku University, Sendai, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 331-333. refs
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The tendency for an increase of the coupling coefficients, which can make the period-ratio be 5:7, is demonstrated in numerical experiments. The smallness of the adiabatic coupling coefficients probably causes the appearance of phase-locking with a high-period ratio; this has been found to be 3:4, 7:9, or 4:5, in prior literature. R.E.P.

A92-55861

ANALYSIS OF THE RESULTS OF TWO-YEAR OPERATIONS OF THE MUNICH DUST COUNTER - A COSMIC DUST EXPERIMENT ON BOARD THE SATELLITE HITEN

A. HUEDEPOHL (BMW Rolls-Royce AeroEngines GmbH, Lohhof, Germany), H. IGLSEDER (ZARM, Center of Applied Space Technology and Microgravity, Bremen, Germany), E. GRUEN (Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany), R. MUENZENMAYER (Munich, Technical University, Germany), H. SVEDHEM (ESTEC, Noordwijk, Netherlands), H. MIZUTANI, T. YAMAMOTO, A. FUJIMURA, and H. ARAKI (Institute of Space and Astronautical Science, Sagami-hara, Japan) *IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992*. 9 p. refs

(IAF PAPER 92-0561) Copyright

The Munich Dust Counter (MDC) is a scientific space experiment on board the Japanese satellite HITEN (MUSES-A). The plasma, that is generated by the impact of cosmic dust particles on a target, is measured to determine mass, velocity and crude flight direction of cosmic dust particles. After a short introduction describing the experiment setup and the satellite mission the results of the two years of operation of the MDC are presented. From these cosmic dust particle measurements preliminary results are derived, which show the cosmic dust flux versus time, particle velocity and mass. The spatial, the directional distribution, and first considerations of the orbital flight velocities of the measured particles will be presented. Results of all MUSES-A mission phases in the geomagnetic tail region of the earth, in the vicinity of the moon and the Lagrangian points (L4 and L5 fly-by) are discussed. Author

A92-56497

EMISSION LINE VARIABILITY OF DR TAU

SYUZO ISOBE, YUJI NORIMOTO, and HAJIME KAWAKAMI (National Astronomical Observatory, Mitaka, Japan) *(IAU, Asian-Pacific Regional Astronomy Meeting, 5th, Sydney, Australia, July 16-20, 1990, Proceedings. A92-56476 24-90) Astronomical Society of Australia, Proceedings* (ISSN 0066-9997), vol. 9, no. 2, 1991, p. 273, 274. refs

Results of CCD observations of DR Tau which show emission line variability are presented. The time dependent variation of the H-beta line and its associated features observed on 1988 December 11 (upper part) and on December 12 (lower part) are illustrated. The present observations indicate that the time-dependent variation of DR Tau's emission line and the inverse P-Cygni absorption line cannot be readily explained by the simple models with gas contraction and gas ejection proposed in previous studies. C.A.B.

A92-56683

RAPID GAS SUPPLY TO A NUCLEAR REGION BY SELF-GRAVITATIONAL INSTABILITY IN A WEAK BARRED POTENTIAL

KEIICHI WADA and ASAO HABE (Hokkaido University, Sapporo, Japan) *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), vol. 258, no. 1, Sept. 1, 1992, p. 82-94. refs (Contract MOESC-03249201)

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Gas dynamics in a weak barred potential is studied with 2D numerical simulations taking into account self-gravity of gas to explain the mechanism of rapid gas inflow into the central region

of a starburst galaxy. The gas is assumed to be initially uniformly distributed inside the corotation radius of the weak barred potential and pursue the self-gravitational gas motion in the case that the inner Lindblad resonance (ILR) exists in this potential. For an initial gas-to-stellar mass ratio greater than 10 percent, a central elongated gas ring becomes unstable and collapses after gas accumulates to form the elongated gas ring near the ILR radius. Dense gas clumps are formed at both sides of the elongated ring and collide with each other in a highly elongated orbit. After frequent collisions, these gas clumps merge and finally form a central dense core. As a result, a large amount of gas is concentrated in the center beyond the ILR radius in a dynamical time-scale after the ring formation. Author

A92-56686

THE EFFECT OF TURBULENT VISCOUS DISSIPATION ON OVERSHOOTING IN STELLAR CONVECTIVE CORES

MINORU UMEZU (Tohoku University, Sendai, Japan) *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), vol. 258, no. 1, Sept. 1, 1992, p. 107-113. refs
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The treatment of turbulent viscous dissipation is improved in the framework of the nonlocal mixing-length theory of Maeder. The larger the turbulent viscous dissipation, the thinner is the convective overshooting region. If the length-scale for the turbulent viscous dissipation is assumed to be equal to the pressure scale-height, a 30-solar-mass model has an overshooting region of moderate extent of about 0.4 H_p1 , where H_p1 is the pressure scaleheight at the classical boundary. With this assumption, the extent of overshooting expressed in units of the pressure scaleheight is almost constant but slightly decreases as the evolution proceeds. However, an unstable shell develops in the envelope. Author

A92-56886

X-RAY SPECTRAL STRUCTURE OF THE SEYFERT GALAXY NGC 6814

M. YAMAUCHI, M. MATSUOKA, N. KAWAI, and A. YOSHIDA (Institute of Physical and Chemical Research, Wako, Japan) *Astrophysical Journal, Part 1* (ISSN 0004-637X), vol. 395, no. 2, Aug. 20, 1992, p. 453-460. Research supported by Institute of Physical and Chemical Research. refs

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We present new and exciting results of a detailed spectral analysis of improved statistical data based on Ginga observations. We show that the overall X-ray spectrum of NGC 6814 rules out the generally favored reflection model as well as a simple power law with an emission line. The spectrum of NGC 6814 has similar features to that of NGC 4151 which is well fitted by a partial covering model. Indeed, we successfully fit the partial covering model to the spectrum of NGC 6814. The main differences between NGC 6814 and NGC 4151 regarding the details of the model are (1) the absorption edge energy of NGC 6814 is around 7.4 - 8.3 keV (in the rest frame) which indicates the presence of a warm gas, while the edge energy for NGC 4151 indicates a cold gas; (2) the iron emission line energies from NGC 6814 are around 6.46 - 6.66 keV which are slightly larger than that for NGC 4151 (about 6.4 keV); (3) the covering factor of NGC 6814 with a dense gas is around 40 percent, while a typical value for NGC 4151 is around 80 percent - 90 percent. Considering those results along with rapid variabilities of the continuum and iron line intensity, the most likely interpretation is that the effects of Doppler shifts from chaotic orbital motion and gravitational and transverse redshifts produce the present iron line and edge energies of NGC 6814. Author

A92-56904

NEUTRINO ENERGY LOSS IN STELLAR INTERIORS. IV - PLASMA NEUTRINO PROCESS FOR STRONGLY DEGENERATE ELECTRONS

NAOKI ITOH, HARUHIKO MUTOH, ATSUSHI HIKITA (Sophia University, Tokyo, Japan), and YASU HARU KOHYAMA (Fuji Research Institute Corp., Tokyo, Japan) *Astrophysical Journal*,

90 ASTROPHYSICS

Part 1 (ISSN 0004-637X), vol. 395, no. 2, Aug. 20, 1992, p. 622-631. refs
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The neutrino energy-loss rates due to plasma neutrino process are calculated for strongly degenerate electrons by using the accurate relativistic dispersion relations for the longitudinal and transverse plasmons. The calculated plasma neutrino energy loss rates are generally valid for relativistically degenerate electrons as well as for nonrelativistically degenerate electrons. The ratio of the result of the present calculation to that of the previous calculations ranges between 0.39 and 3.22 depending upon densities and temperatures. The results of the calculation are expressed by an analytical fitting formula. Author

A92-56915

SURVIVING COSMOLOGICAL MODELS AFTER THE DISCOVERY OF LARGE-ANGLE ANISOTROPIES OF THE COSMIC MICROWAVE BACKGROUND

NAOTERU GOUDA (Kyoto University, Japan) and NAOSHI SUGIYAMA (Tokyo, University, Japan) Astrophysical Journal, Part 2 - Letters (ISSN 0004-637X), vol. 395, no. 2, Aug. 20, 1992, p. L59-L63. refs
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Using new and first detections of the rms temperature fluctuations at 10 deg and the quadrupole anisotropy on the cosmic microwave background radiation by the COBE group together with the upper limits on small-scale anisotropies, constraints on various cosmological models are obtained. Complete analysis of the quadrupole anisotropy for flat and open universe models has been done. We calculate not only the Sachs-Wolfe effect and the effect of time variation of the gravitational potential, but also the intrinsic fluctuations from the initial perturbations at the decoupling time which play an important role in many cosmological models, in particular, models with initially isocurvature perturbations. With the results of COBE and the upper limits on small-angle observations of temperature fluctuations, we found that CDMs with $h = 1.0$ and HDMs with $h = 0.5$ are surviving if we consider only models which are consistent with the inflationary scenario. Author

A92-56974

ANALYTICAL EXPANSIONS OF TORQUE-FREE MOTIONS FOR SHORT AND LONG AXIS MODES

HIROSHI KINOSHITA (National Astronomical Observatory, Mitaka, Japan) Celestial Mechanics and Dynamical Astronomy (ISSN 0923-2958), vol. 53, no. 4, 1992, p. 365-375. refs
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Simple analytical expansions of torque-free motions for short- and long-axis modes are presented which are correct up to the second-order of a smaller parameter. These expressions include only trigonometric functions and can be evaluated by hand calculation for estimates of the essential quantities from which one can determine a global rotational motion of the torque-free motion. They can also be used as the zero-th order solution in a perturbation method when the motion is perturbed by external torques. Author

A92-57385

SIMILARITY BETWEEN THE STRUCTURE AND STABILITY OF ISOTHERMAL AND POLYTROPIC GAS SPHERES

S. YABUSHITA (Kyoto University, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 193, no. 2, July 1992, p. 173-183. refs
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As shown by Chieze (1987), polytropic gas spheres imbedded in an ambient medium with a given pressure exhibit a relation between the mass and radius similar to isothermal gas spheres, provided n (polytropic index) is greater than 3 or less than -1. Further investigation is made of the polytropic spheres. Not only the relation between radius and external pressure, but the relation between the central density (ρ sub c) and the mass (M) is similar to isothermal spheres and neutron star models. Dynamical calculation shows that the stability of polytropic spheres is lost at

the configuration which corresponds to the first peak in the ρ sub c - M relation, as is the case for neutron star models in general relativity. Author

N92-16962# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.

POST-NEWTONIAN EQUATIONS OF MOTION IN FLAT COSMOLOGICAL MODELS

KENJI TOMITA Feb. 1991 11 p
(DE91-508175; YITP/U-91-14) Avail: CASI HC A03/MF A01

The post-Newtonian equations of motion for particles in an expanding universe are derived in spatially flat models with cosmological constants. This system of equations is an extended version of the previous one which was derived in the Einstein-de Sitter model. The applicability condition is also examined and some errors found in the previous expressions are indicated and corrected. DOE

N92-70962 National Inst. of Polar Research, Tokyo (Japan).

JARE DATA REPORTS. NO. 155 (IONOSPHERE 42).

RIOMETER RECORDS OF 30 MHZ COSMIC NOISE AT SYOWA STATION, ANTARCTICA, 1988

HIDEO MAENO, ATSUSHI OHTSUKA, TAKAO HOSHIAI, ed., MASAKI EJIRI, ed., KATSUTADA KAMINUMA, ed., IKUO KUSHIRO, ed., MASAYUKI TAKAHASHI, ed., OKITSUGU WATANABE, ed., TORAO YOSHIKAWA, ed., YOSHIYUKI FUJII, ed. et al. Mar. 1990 101 p
(ISSN 0075-3343)

Avail: CASI HC A06

Observations of cosmic radio noise with a standard riometer (relative ionospheric opacity meter) at 30 MHz were carried out at Syowa Station, Antarctica, since February 1966 by members of the Communications Research Laboratory. A report was prepared which includes hourly values and chart records of cosmic noise absorption observed during the period from January 1 to December 31, 1988. Author

N92-71144 National Inst. of Polar Research, Tokyo (Japan).

JARE DATA REPORTS. NO. 141 (IONOSPHERE 39).

RIOMETER RECORDS OF 30 MHZ COSMIC NOISE AT SYOWA STATION, ANTARCTICA, 1987

HIDEO MAENO, KOJI INAMORI, TAKAO HOSHIAI, ed., MASAKI EJIRI, ed., KATSUTADA KAMINUMA, ed., IKUO KUSHIRO, ed., MASAYUKI TAKAHASHI, ed., OKITSUGU WATANABE, ed., TORAO YOSHIKAWA, ed., YOSHIYUKI FUJII, ed. et al. Mar. 1989 102 p
(ISSN 0075-3343)

Avail: CASI HC A06

Observations of cosmic radio noise with a standard riometer (relative ionospheric opacity meter) at 30 MHz have been carried out at Syowa Station, Antarctica, since February 1966. This report provides a bibliography of records of these observations, a description of the instrumentation used in recording the noise, and charts that show 30 MHz cosmic noise absorption (in dB) at the first minute of each hour for the year 1987. Also recorded and charted are the cosmic noise intensity and geomagnetic H-component at Syowa Station. J.P.S.

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LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

A92-10677

MINERALOGY OF INTERSTITIAL RIM MATERIALS OF THE Y74123 AND Y790981 UREILITES AND THEIR ORIGIN

HIROMI OGATA, HIROSHI MORI, and HIROSHI TAKEDA (Tokyo, University, Japan) Meteoritics (ISSN 0026-1114), vol. 26, Sept.

1991, p. 195-201. Research supported by University of Tokyo, MOESC, and Mitsubishi Foundation. refs
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Y74123 is an olivine-rich, relative unshocked ureilite and contains more interstitial pigeonitic materials than do ureilites which have been reported previously. These materials were studied by optical microscope, electron microprobe, SEM, high-resolution TEM, and analytical TEM to gain a better understanding of their nature and origin. The Y790981, with shock partial melts, has also been examined by the same techniques. Bulk chemical compositions of the interstitial materials in Y74123 are pyroxene-like and have higher CaO and Al₂O₃ contents than the large pigeonite and olivine core. Interstitial materials at olivine-pigeonite grain boundaries are riched in CaO and Al₂O₃ than those at olivine-olivine grain boundaries. TEM observations of the interstitial material of Y74123 show that it consists of alternating pigeonite-augite lamellae more than 3.5-micron thick on (001). This texture suggests that the rim material had already crystallized before the parent body breakup. The shock-produced glassy veins in Y790981 cut through the rim materials. These observations are consistent with the idea that the interstitial materials in this ureilite are a mixture of residual liquids of high Ca melts and shock-produced partial melts of olivine and pigeonite. This mixture accumulated along the grain boundaries and some of it is trapped within grains. Author

A92-10680

ANOMALOUS NE ENRICHMENTS IN TEKTITES

KAYO MATSUBARA (Kobe University, Japan) and JUN-ICHI MATSUDA (Osaka University, Toyonaka, Japan) Meteoritics (ISSN 0026-1114), vol. 26, Sept. 1991, p. 217-220. refs
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Noble gases and Ne isotopic compositions were measured in five tektites collected from three different strewn fields. The elemental abundance patterns of noble gases in all samples show anomalous Ne enrichments relative to air. Ne isotopic compositions in tektites are in good agreement with that of atmospheric Ne, suggesting that Ne has diffused in from the atmosphere. It is conceivable that the high relative Ne abundance is essentially an equilibrium effect (i.e., storage of Ne in vesicles rather than the glass itself, facilitated by the relatively high diffusion coefficient of Ne). Author

A92-12966

EVOLUTION OF LUNAR TOPOGRAPHY BY IMPACT PROCESSES

SEIJI SUGITA and TAKAFUMI MATSUI (Tokyo, University, Japan) Geophysical Research Letters (ISSN 0094-8276), vol. 18, Nov. 1991, p. 2125-2128. Research supported by MOESC. refs
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A simple model of lunar topographic evolution resulting from the formation of impact craters is used in an attempt to constrain the total number of impactors striking the moon after the solidification of the lunar crust. The numerical results indicate that the evolution of the moon's hypsometric curve is strongly influenced by the total number of craters and is less affected by their size distribution. It is suggested that the total number of craters necessary to explain the standard deviation of the present hypsometric curve is roughly equivalent to the number density of craters on the oldest lunar crust, corresponding to about 10×10^4 lunar mass of impactors. This may be the total mass of impactors striking after solidification of the lunar crust, more specifically, after about 4.4 to 4.5 Ga ago when the viscous degradation of craters became ineffective. Author

A92-13186

THE MICROMETEORIDS IN THE THERMOSPHERE AND MESOSPHERE

FUMIO KAMIJO (Tokyo, University, Japan) Astrophysics and Space Science (ISSN 0004-640X), vol. 184, no. 1, Oct. 1991, p. 147-152. refs
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The variation of temperature and radius of typical

micrometeoroids in the low thermosphere and mesosphere is calculated theoretically, and the formation of the spherule is explained consistently with this model. The fluffy particles floating in the stratosphere is also consistent with this calculation, since the particle of radius 10 microns and initial velocity 20 km/s cannot be heated up to the sublimation temperature, even if it is not fluffy. This calculation coincides exactly heights and velocities of meteor streams. The formation of the secondary particles from the evaporated vapor is also calculated, and it is concluded that they are very few and small, compared with the primary particles. Author

A92-14802

MINERAL-CHEMICAL COMPARISONS OF MAC88105 WITH YAMATO LUNAR METEORITES

HIROSHI TAKEDA, HIROSHI MORI, JUN SAITO, and MASAMICHI MIYAMOTO (Tokyo, University, Japan) (The MacAlpine Hills Lunar Meteorite Consortium - Lunar and Planetary Science Conference, 21st, Special Session, Houston, TX, Mar. 12, 1990) Geochimica et Cosmochimica Acta (ISSN 0016-7037), vol. 55, Nov. 1991, p. 3009-3017. Research supported by University of Tokyo, MOESC, and Mitsubishi-Foundation. refs
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The new lunar meteorite MAC88105 has been studied by mineral-chemical techniques and was compared with the Yamato lunar meteorites. Clast types and pyroxene compositions of MAC88105 indicate that evidence for a pairing with any known lunar meteorites is unlikely. Clast-laden vitric breccia and comminuted mineral fragments in glassy matrix are common components as in other lunar meteorites, but granulitic clasts are not as common as in other lunar meteorites. The large and common granulite-like meta-igneous clasts still preserve lath-shaped plagioclase crystals with fine-grained olivine and pyroxenes in the interstices. Pyroxenes with mg number = $Mg \times 100 / (Mg + Fe)$ between 70-48 mol pct are common, but more Mg-rich pyroxenes and plutonic pyroxenes from nonmare pristine crustal rocks are rare. One basaltic clast contains pyroxenes with zoning trends more Mg-rich than the above mg range and than those of the VLT basalts common in lunar meteorites. MAC88105 preserves true glass in the matrix as observed by a transmission electron microscope. The preservation of glassy materials indicates that MAC88105 had a metamorphic annealing history different from other lunar meteorites. Author

A92-15760

ON THE ORIGIN OF THE PLANETARY SPIN BY ACCRETION OF PLANETESIMALS. II - COLLISIONAL ORBITS AT THE HILL SURFACE

K. TANIKAWA (National Astronomical Observatory, Mitaka, Japan), N. KIKUCHI, and I. SATO (National Astronomical Observatory, Mizusawa, Japan) Icarus (ISSN 0019-1035), vol. 94, Nov. 1991, p. 112-125. refs
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The planar-restricted three-body problem furnishes the framework for the present numerical investigation of the structure of the totality of orbits, beginning at the Hill surface. In addition to clarifying the qualitative features of the totality of orbits at the Hill surface, a general formula is obtained for the collisional probability as a function of mass ratio, radius, and Jacobi constant. The range of the Jacobi constant corresponding to its Hill problem value in the three-body case is also obtained, and the collisional probability is given as a function of the velocity at the Hill surface. O.C.

A92-15771

DOES DEBRIS FROM THE FORMATION OF OTHER PLANETARY SYSTEMS IMPACT EARTH?

THOMAS G. BROPHY (Tokyo, University, Japan) Icarus (ISSN 0019-1035), vol. 94, Nov. 1991, p. 250-254. refs
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Model size distributions for the ejected debris from extrasolar planet formation are used to calculate the small and large particle fluxes impacting earth, on the assumption that the framework of

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the standard solar system formation scenario can be applied to other planetary systems. Long Duration Exposure Facility-detected and Kharkov radar-detected impactors with extrasolar velocities are interpretable along these lines, as are several recovered meteorites. O.C.

A92-16181

MAGNESIUM ISOTOPIC FRACTIONATION OF SILICATES PRODUCED IN CONDENSATION EXPERIMENTS

CHIAKI UYEDA, AKIRA TSUCHIYAMA, and JUN OKANO (Osaka University, Toyonaka, Japan) Earth and Planetary Science Letters (ISSN 0012-821X), vol. 107, no. 1, Oct. 1991, p. 138-147. Research supported by MOESC. refs
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The present study investigates isotopic mass fractionations for silicates produced in condensation experiments for the purpose of studying the evaporation-condensation process in the early solar nebula in connection with the isotopic data observed in various primitive materials. The silicate gas was fractionated to produce condensates at various temperatures below 1350 C down to room temperature, and the amount of isotopic mass fractionation varied considerably with the condensation temperature, T_c . The variation in the Mg-26/Mg-24 ratio with respect to the initial evaporation source, Delta-26, varies from +8 to -30 percent as T_c changes from 1350 C to room temperature. The obtained (Delta-26) - T_c relationship is explained in terms of the Rayleigh fractionation model, and the relationship indicates that the condensates fractionated isotopically toward the heavy mass with respect to the gas phase at temperatures from 700 to 1350 C. The findings show that the condensates can be fractionated both toward the heavy and light isotopes with respect to the initial source according to the fraction of the residual gas phase. C.A.B.

A92-18669

LIGHT SCATTERING BY ROUGH SURFACES ON ASTEROIDAL/LUNAR REGOLITHS

TADASHI MUKAI and SONOYO MUKAI (Kanazawa Institute of Technology, Japan) (Space dust and debris; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission B /Meetings B2, B3, and B5/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-18651 05-12) Advances in Space Research (ISSN 0273-1177), vol. 11, no. 12, 1991, p. 137-140. refs
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The light scattering properties of a rough surface with feature size comparable to the wavelength of interest, which is similar to the surface consisting of coarse regolith, are estimated from Mie theory for representing the roughness as an ensemble of noninteracting spheres. It is found that a disk-integrated linear polarization deduced from singly scattered rays by Mie theory is smaller than that resulting from Fresnel reflection for a rough surface of fine regolith. In addition, negative polarization in the back scattering region observed in asteroids is well described by a mixing model of coarse and fine regoliths. Author

A92-19329

METHANE BAND PHOTOMETRY OF THE FADED SOUTH EQUATORIAL BELT OF JUPITER

TAKEHIKO SATOH and KIYOSHI KAWABATA (Tokyo, Science University, Japan) Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 384, Jan. 1, 1992, p. 298-304. refs
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Results are presented of a preliminary analysis of the limb-darkening curves along the unusually faint Jovian South Equatorial Belt (SEB), observed in early 1990. Three limb-darkening curves extracted from the CCD images obtained in two strong methane bands at 0.725 and 0.890 micron plus one nearby continuum region (0.750 micron) are compared with the theoretical computations, taking the effect of multiple light scattering into account. The single-scattering albedo for the particles comprising the visible cloud layer is found to be almost unity in contrast to its typical value of 0.991 deduced by Tomasko et al. (1978) for the typical dark state of the SEB. It is also suggested that a

large-scale lifting of the entire lower cloud layer is likely to have taken place in this region. The cloud type is so close to the bottom of the upper cloud that they are nearly in contact. It is concluded that cause of these changes in the SEB may be an unusual updraft motion from the deeper level of the atmosphere. P.D.

A92-21955

FORMATION OF SHARP RINGLETS BY INELASTIC COLLISIONS

KOICHIRO SHIDA, KIYOHITO SUZUKI, and TOSHIO KAWAI (Keio University, Yokohama, Japan) Physical Society of Japan, Journal (ISSN 0031-9015), vol. 60, Nov. 1991, p. 3953-3966. refs
Copyright

The possibility that the sharp ringlets observed around giant planets of the solar system are generated through inelastic collisions is investigated. First, a model is defined, and then ringlet formation is shown to occur under certain conditions on the rebound coefficients. A 3D case with 2000-body was then simulated. If the condition is satisfied, particles under the gravitational influence of a planet are shown to evolve from a 3D torus to a 2D disk, and finally to 1D ringlets. The form is thus simplified through inelastic collisions. This result is contrary to the common notion that collisions among the constituents of planetary rings would cause the rings to lose their sharp features. Author

A92-22394* Hiraiso Solar Terrestrial Research Center, Ibaraki (Japan).

THE IONOSPHERIC EFFECTS OF A WEAK INTRINSIC MAGNETIC FIELD AT MARS

H. SHINAGAWA (Communications Research Laboratory, Ibaraki, Japan) and T. E. CRAVENS (Kansas, University, Lawrence) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, Jan. 25, 1992, p. 1027-1035. refs
(Contract NAGW-1588; NSF ATM-89-96116)
Copyright

An improved model of the Martian ionosphere which allows the magnetic field to have any direction in the horizontal plane is presented, as well as results of calculations for several different intrinsic magnetic field strengths and directions. When the solar wind dynamic pressure exceeds the Martian ionospheric thermal pressure, the plasma motion is weakly downward throughout the ionosphere for the case of no intrinsic magnetic field, but when the intrinsic and induced fields are in opposite directions, the plasma flow tends to converge toward the current sheet. As a consequence of this convergence, the plasma density is somewhat enhanced near the current sheet, which is located near an altitude of 170 km. The ionosphere above an altitude of about 190 km is not significantly affected by the existence of an intrinsic field as weak as 60 nT. P.D.

A92-24541* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.

MEASUREMENT OF JOVIAN DECAMETRIC IO-RELATED SOURCE LOCATION AND BEAM SHAPE

K. MAEDA (Hyogo College of Medicine, Nishinomiya, Japan) and T. D. CARR (Florida, University, Gainesville) Journal of Geophysical Research (ISSN 0148-0227), vol. 97, Feb. 1, 1992, p. 1549-1556. refs
(Contract NSF AST-89-20861; NAG5-773)
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The paper presents new information on the locations of the io-related sources A and C (i.e., io-A and io-C) and on the shapes of their emission beams on the basis of measurements of the Jovian decametric activity that was recorded by Voyager 1 and 2. In two instances, the same dynamic spectral arc event in the recorded data of the two spacecraft was recorded, providing in each case an opportunity to observe the same emission beam over a wide range of frequencies from two considerably different directions. The propagation-corrected centroid times of each of the Voyager-1 arcs are found to be coincident with those of the corresponding Voyager-2 arc in a particular frequency range, but not at other frequencies. The hypothesis that emission beams are

in the form of thin, almost conical sheets, the cone opening angle decreasing with increasing frequency, is confirmed. It is demonstrated that both the lo-A and lo-C sources were located near the northern foot of the magnetic flux tube that was connected to lo. P.D.

A92-25795#

LUNAR PENETRATOR MISSION

H. MIZUTANI, M. KOHNO, A. FUJIMURA, I. YAMADA, S. TANAKA, and M. HAYAKAWA (Institute of Space and Astronautical Science, Sagami-hara, Japan) AIAA, Aerospace Sciences Meeting and Exhibit, 30th, Reno, NV, Jan. 6-9, 1992. 7 p. refs (AIAA PAPER 92-0357) Copyright

Institute of Space and Astronautical Science (ISAS), Japan, plans to undertake a lunar mission, named LUNAR-A, which is to be launched in early 1996. The scientific objective of the mission is to explore the lunar interior using seismometry and heat-flow measurement toward better understanding of the origin and evolution of the moon. The M-V, the newest version of the Mu series launch vehicles now under development, is used to send a 550 kg of spacecraft to the lunar transfer orbit. Three penetrators (which are missile-shaped instrument carriers) are deployed from a spacecraft onto the lunar surface, and constitute a seismic and heat-flow measurement network of a larger span than the Apollo ALSEP network. The present paper describes the outline and scientific implications of the ISAS lunar penetrator mission.

Author

A92-30881

MINERALOGICAL STUDIES OF LUNAR MARE METEORITES EET87521 AND Y793274

HIROSHI TAKEDA, HIROSHI MORI, JUN SAITO, and MASAMICHI MIYAMOTO (Tokyo, University, Japan) IN: Proceedings of Lunar and Planetary Science, Volume 22; Conference, Houston, TX, Mar. 18-22, 1991. Houston, TX, Lunar and Planetary Institute, 1992, p. 355-364. Research supported by University of Tokyo and MOESC. refs

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Polished thin sections of lunar meteorites EET87521 and Y793274, possibly derived from a mare region of the moon, have been analyzed for the mineral chemistries and textures. Basaltic components in both objects contain strongly zoned Fe-Ca-rich pyroxenes like those found in the VLT basalts. A mesostasis portion found in a basaltic clast of EET87521 consists of ilmenite, minor Cr-Ti spinel mantled by fayalite Fo10-prime, and fine-grained mixtures of hedenbergite and fayalite in contact with a silica mineral. Mg-rich materials are rare in EET87521 but abundant in Y793274. The latter contains the most Mg-rich clast found in lunar samples with orthopyroxene and ilmenite, a gabbroic clast with finely exsolved pigeonite, olivine, and plagioclase, and pyroxene clasts intermediate between those in the basaltic and the Mg-rich clast types. A pyroxene fragment in EET87521 shows exsolution lamellae of augite about 300 nm wide, which is consistent with mare basalt origin. C.D.

A92-31143

EQUILIBRIUM VELOCITIES IN PLANETARY RINGS WITH LOW OPTICAL DEPTH

KEIJI OHTSUKI (Tokyo, University, Japan) Icarus (ISSN 0019-1035), vol. 95, Feb. 1992, p. 265-282. refs (Contract MOESC-01611002; MOESC-02952094) Copyright

An examination is conducted of equilibrium velocities in planetary rings with low optical depth, where the epicyclic approximation for particle motion is applicable. Analytic expressions are derived for the evolutionary rate in the case where the particle restitution coefficient is independent of impact velocity. Inclusion of particle gravity via orbital calculations of the three-body problem indicates, in the case of random velocity smaller than the escape velocity, that not only direct collisions but gravitational scattering are contributors to rapid random-velocity enhancement; eccentricity is noted to grow much more rapidly than inclination. An examination of equilibrium velocities for two-component systems for arbitrary

mass ratios shows that while smaller particles' equilibrium velocity is determined by the velocity-dependent restitution coefficient, the velocity of larger particles tends toward energy balance with smaller particles in many cases. O.C.

A92-31586

EFFECTS OF THE TIDAL DISSIPATION ON THE MOON'S ORBIT AND THE EARTH'S ROTATION

M. OOE, H. SASAKI (Mizusawa, International Latitude Observatory, Japan), and H. KINOSHITA (Tokyo Astronomical Observatory, Mitaka, Japan) IN: Variations in earth rotation. Washington, DC, American Geophysical Union, 1990, p. 51-57. refs Copyright

Exact expressions for tidal perturbations of the moon's orbit and the earth's rotation are given. Then M2 tidal models of present-day oceans and a permian ocean are computed by solving discrete tidal equations. These models are used to estimate the process of the dynamical evolution of the earth-moon system. Obtained results suggest that the Gerstenkorn date is close to 6 billion years ago. Author

A92-32217

N-BODY SIMULATION OF GRAVITATIONAL INTERACTION BETWEEN PLANETESIMALS AND A PROTOPLANET. I - VELOCITY DISTRIBUTION OF PLANETESIMALS

SHIGERU IDA and JUNICHIRO MAKINO (Tokyo, University, Japan) Icarus (ISSN 0019-1035), vol. 96, March 1992, p. 107-120. refs

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The distribution of eccentricities (e) and inclinations (i) of planetesimals in a planetesimal swarm was investigated using 3D N-body simulations and assuming that the e and the i magnitudes of the planetesimals are determined by perturbation between themselves. It is found that the e,i-distribution of identical 400 nonaccreting equal-mass bodies is expressed with high accuracy by Gaussian distribution. Theoretical arguments are presented showing that the dynamical friction under the Gaussian distribution is strong enough to depress the e and i magnitudes of a protoplanet to values satisfying the energy equipartition with those of planetesimals. This result supports the existence of runaway growth. I.S.

A92-32306

MANNED EXPLORATION OF MARS - REQUIREMENTS FOR FUTURE SPACE FLIGHT AND RECOMMENDATION FOR INTERNATIONAL COOPERATION [DIE BEMANNTE ERFORSCHUNG DES PLANETEN MARS - HERAUSFORDERUNG DER RAUMFAHRT FÜR DIE ZUKUNFT UND FORDERUNG NACH INTERNATIONALER ZUSAMMENARBEIT]

RUDI G. REICHERT (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) Astronautik (ISSN 0004-6221), vol. 28, Oct.-Dec. 1991, p. 103-106. In German. refs

Copyright

The prospects for manned space flight projects in the USA, Russia, Europe, and Japan are briefly addressed. The possible achievements of the SEI are addressed. Affordable technologies for manned exploration of Mars are listed. C.D.

A92-33852

MEASUREMENT OF COSMOGENIC NITROGEN USING A STATIC MASS-SPECTROMETRY SYSTEM AND ITS IMPLICATION

KO HASHIZUME and NAOKI SUGIURA (Tokyo, University, Japan) Geochimica et Cosmochimica Acta (ISSN 0016-7037), vol. 56, April 1992, p. 1625-1631. refs

(Contract MOESC-63611508)

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The case of the anomalous phenomena observed by Hashizume and Sugiura (1990) during the mass spectroscopy of N2 gas enriched in a cosmogenic component is considered. It is argued that the only possible consistent explanation for the phenomena is that the nitrogen molecules are not isotopically

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equilibrated between the trapped nitrogen component and the cosmogenic nitrogen component whose isotopic ratios are extremely different. Results are presented of numerical and experimental simulations to explain the observed phenomena on the basis of the hypothesis of the isotopic nonequilibrium of nitrogen molecules. Incomplete isotopic equilibration of nitrogen molecules may lead to an underestimation of the amount of cosmogenic nitrogen by a factor of approximately 2. P.D.

A92-38145* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SOME UNIQUE METEORITES FOUND IN ANTARCTICA AND THEIR RELATION TO ASTEROIDS

HIROSHI TAKEDA (Tokyo, University, Japan), MICHAEL B. DUKE (NASA, Johnson Space Center, Houston, TX), TERUAKI ISHII, HIROSHI HARAMURA (Tokyo, University, Japan), and KEIZO YANAI (National Institute of Polar Research, Tokyo, Japan) National Institute of Polar Research, Memoirs (ISSN 0386-0744), no. 15, 1979, p. 54-76. Research supported by MOESC. refs Copyright

Two unique meteorites were identified by means of a mineralogical examination of the smaller-sized Yamato achondrites. Yamato-74130 is the most iron-rich ureilite with Na, Cr-rich augite instead of pigeonite. Yamato-74160 was extensively recrystallized, but the composition and proportion of olivine, orthopyroxene, augite, and plagioclase is consistent with LL7 chondrites. ALHA77005 is a unique achondrite with olivine, possibly three pyroxene assemblages, and maskelynite. These meteorites provide evidence that there may be other 'thermalized' asteroids than the howardite parent body. Detailed petrologic descriptions of the unique achondrites, recrystallized diogenite Yamato-74013, and the rapidly cooled eucrite Yamato-74450 with pyroxene phenocrysts are given. It is inferred from the bulk chemistry and the mineralogical reexamination of Yamato-75028 that it is composed of the H5-type clasts and chondrule-rich H(L)3-like matrix with the H5 fragments. A close relationship in the collisional evolution of some asteroids with these materials is inferred. P.D.

A92-46302

NA-BEARING CA-AL-RICH INCLUSIONS IN THE YAMATO-791717 CO CARBONACEOUS CHONDRITE

KAZUSHIGE TOMEOKA (Tokyo, University; Kobe University, Japan), KOJI NOMURA (Tokyo, University; Onoda Cement Co., Ltd., Japan), and HIROSHI TAKEDA (Tokyo, University, Japan) Meteoritics (ISSN 0026-1114), vol. 27, no. 2, June 1992, p. 136-143. Research supported by Mitsubishi Scientific Foundation. refs (Contract MOESC-01611506; MOESC-6340003) Copyright

Ca-Al-rich inclusions (CAIs) in the Yamato-791717 CO carbonaceous chondrite contain 5 to 80 vol pct of nepheline, along with minor sodalite, and thus are among the most nepheline-rich CAIs known. The primary phases in inclusions are mainly spinel, fassaite, aluminous diopside, perovskite, and hibonite. In contrast to many CO chondrites, melilite is rare. Spinel contains variable amounts of Fe (0 to 57 mol pct FeAl₂O₄) and is commonly zoned. Texture suggests that nepheline is a secondary alteration product formed by replacing mainly melilite, fassaite, and spinel; melilite is the most susceptible to alteration of the primary phases, so most of it was probably already consumed to form nepheline. The majority of inclusions are single concentric objects or aggregates of concentric objects. Lightly altered inclusions have cores of spinel surrounded by bands of nepheline (replacing fassaite), fassaite, and diopside. In moderately altered inclusions, spinel cores are replaced by nepheline. In heavily altered inclusions, the major part of internal areas (50 to 80 percent in volume) are replaced by nepheline. In some moderately and heavily altered inclusions, only diopside rims remain unaltered. Textural relationships indicate that the resistance of primary phases to alteration increases in the order melilite, fassaite, spinel, diopside. The alteration probably proceeded with reaction of the primary phases with the low-temperature (less than 1000 K) nebular gas rich in Na, Fe and Cl. The degree of alteration in Y791717 CAIs

appears to be much higher than those in CAIs in other reported meteorites. Author

A92-46308

THE HASHIMA, JAPAN H4 CHONDRITE - A NEWLY REPORTED METEORITE

MITSUO HOSHINO and KANENORI SUWA (Nagoya University, Japan) Meteoritics (ISSN 0026-1114), vol. 27, no. 2, June 1992, p. 179-181. refs Copyright

A new chondrite is reported that fell in Hashima City in central Japan sometime during the period 1868-1912. The chondrite weighs 1110.64 g and exhibits distinct chondritic structure. Chondrules occupy 24 vol pct of the stone and consist of olivine (average Fa(17.8)), low-Ca pyroxene (average Fs(15.8)Wo(0.9)), devitrified glass and lesser amounts of oligoclase (ca. Ab₈₀Or₄), kamacite, taenite, troilite, and chromian spinel. Matrix occupying 76 vol pct of the stone consists of olivine, low-Ca pyroxene, kamacite, taenite, troilite, cryptocrystalline minerals, and lesser amounts of chromian spinel and chlorapatite. Matrix minerals have the same compositions as those in chondrules. Mineral chemistry, bulk chemistry, and magnetic properties indicate that Hashima is an H-group chondrite. Well-defined chondrules, scarcely recrystallized oligoclase, and relatively small variations of olivine and low-Ca pyroxene compositions indicate that Hashima is of petrologic type 4. Author

A92-46710

SHEPHERDING SATELLITES AND DYNAMICAL STRUCTURE OF THE RINGS OF URANUS

YOSHIIHIDE KOZAI (National Astronomical Observatory, Mitaka, Japan) PASJ: Publications of the Astronomical Society of Japan (ISSN 0004-6264), vol. 44, no. 2, 1992, p. 135-139. refs Copyright

The structure of the alpha, beta, and epsilon rings of Uranus, with noncircular orbits, the eccentricities increasing as the semimajor axes and the apsidal motions common in each ring, is explained by the gravitational action of unknown shepherding satellites, which produce appreciable eccentricities to the rings. Their orbits are much closer to the rings than any of the shepherding satellites discovered by the Voyager spacecraft. Since the eccentricities of the ring particles are shown to be produced due to actions of the satellite in this paper, their apsidal motions are synchronized in each ring and are equal to that of the shepherding satellite. Since the eccentricity is increased toward the outer edge of the ring, the satellite must be outside of the ring by 10-100 km apart from the outer edge of the ring. Their masses are estimated to be of the order of 10 exp -11 - 10 exp -10 of that of Uranus, that is, 10 exp 18 - 10 exp 19 g, and are less than that of any known satellite. Author

A92-50886

EVOLUTION OF RANDOM VELOCITIES OF PLANETESIMALS IN THE COURSE OF ACCRETION

KEIJI OHTSUKI (Tokyo, University, Japan) Icarus (ISSN 0019-1035), vol. 98, no. 1, July 1992, p. 20-27. refs (Contract MOESC-02952094) Copyright

The present examination of the role of accretion in planetesimals' random velocity evolution proceeds according to an equation for such evolution that is couched in terms of planetesimal orbits' eccentricity and inclination within the framework of Hill's approximations. The dissipation of random velocity by accretion leads to equipartition of the kinetic energy of random motion between planetesimals having different masses. At the earth's orbit, solar nebula gas drag, gravitational scattering, and accretion appear to contribute to the early stages of planetesimal accumulation's velocity evolution up to sizes of about 10 exp 20 g; they become less effective thereafter, and equilibrium velocities of planetesimals may then be determined by the interval between gravitational scattering and gas drag. O.C.

A92-50887

N-BODY SIMULATION OF GRAVITATIONAL INTERACTION BETWEEN PLANETESIMALS AND A PROTOPLANET. II - DYNAMICAL FRICTION

SHIGERU IIDA and JUNICHIRO MAKINO (Tokyo, University, Japan) *Icarus* (ISSN 0019-1035), vol. 98, no. 1, July 1992, p. 28-37. refs

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N-body 3D simulations are presently conducted for the dynamical friction of planetesimals with a view to the likelihood of runaway growth in the cases of both four-component systems with slightly different masses and a protoplanet that is embedded in a swarm of small planetesimals. While runaway growth in the former case begins in an early-stage planetesimal swarm which has a continuous mass distribution, the latter case involves a simultaneous decrease of a protoplanet's eccentricity and inclination due to the dynamical friction generated by the planetesimals. This scenario's decay timescale is characterized by the semianalytical theory of Iida (1990) and supports the protoplanet's runaway growth. O.C.

A92-51953

NON-ADIABATIC ACCELERATION OF MAGNETOSPHERIC PARTICLES

A. NISHIDA (Institute of Space and Astronautical Science, Sagami-hara, Japan) (Planetary magnetospheric physics II; Proceedings of Symposium 5 and the Topical Meetings of the Interdisciplinary Scientific Commission B /Meetings B1 and B6/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-51951 22-91) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 8, Aug. 1992, p. 15-22. refs

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Classical radial diffusion alone cannot explain the composition, intensity and anisotropy of energetic ions and electrons observed in planetary magnetospheres. This paper reviews proposed nonadiabatic acceleration mechanisms and discuss if they can fill the gap between predictions of the radial diffusion model and the observations. The nonadiabatic acceleration models discussed here include the particle motions in the current sheet, wave-particle interactions, field-aligned electric field, recirculation, and magnetic pumping. Author

A92-51973

A NEW SCALING LAW OF THE PLANETARY MAGNETIC FIELDS

HITOSHI MIZUTANI, TETSUO YAMAMOTO, and AKIO FUJIMURA (Institute of Space and Astronautical Science, Sagami-hara, Japan) (Planetary magnetospheric physics II; Proceedings of Symposium 5 and the Topical Meetings of the Interdisciplinary Scientific Commission B /Meetings B1 and B6/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-51951 22-91) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 8, Aug. 1992, p. 265-279. refs

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A new scaling law for the planetary magnetic field strengths is obtained assuming the magnetostrophic balance. The velocity of the convection current $v(c)$ in a planetary core is estimated by the geometric mean of the possible maximum and minimum values to be $v(c) = c(\sqrt{\Omega/4\pi\mu\sigma})$, where Ω is angular velocity of the core rotation, σ the electric conductivity, c speed of light, and μ the magnetic permeability. Overall agreement of the prediction by the present new scaling law with the data on magnetic field strengths of various planets is superior to those by previously proposed scaling laws. The present scaling law is also found to predict well the Neptune's magnetic field recently determined by the Voyager 2 observation. Success of the present scaling law on the planetary magnetic field strength suggests that the magnetostrophic balance may be a good approximation for planetary dynamo and that toroidal magnetic field is dominant over the poloidal field in the core. Author

A92-52587

NITROGEN ISOTOPE ANOMALIES IN PRIMITIVE ORDINARY CHONDRITES

NAOJI SUGIURA and KO HASHIZUME (Tokyo, University, Japan) *Earth and Planetary Science Letters* (ISSN 0012-821X), vol. 111, no. 2-4, July 1992, p. 441-454. refs

(Contract MOESC-63611508)

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Large anomalies in nitrogen isotopic composition were found in two type-L3 ordinary chondrites. One of them is isotopically heavy, and the other is isotopically light. The carriers of anomalous nitrogen are partly soluble in HCl. Thus, the anomalies are probably due to new types of presolar grains, although they have not been identified yet. Trapped Ar-36 in these chondrites seems to be associated with this anomalous nitrogen, and may be presolar in origin. The presence of two different nitrogen isotopic anomalies suggests that the parent body of L chondrites, and also the primitive solar nebula, were not homogeneous. Nitrogen isotope anomalies seem to be useful in detecting subdivisions of chemical groups of chondrites. Author

A92-53722* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

RADIO SCIENCE EXPERIMENT OF VOYAGER-2 SPACECRAFT OCCULTATION BY NEPTUNE

T. HAYASHI, T. NISHIMURA, T. TAKANO, Z. YAMAMOTO, M. YAMADA, K. SHUTO, H. SAITO, T. ICHIKAWA, N. KAWASHIMA, E. MIZUNO (Institute of Space and Astronautical Science, Sagami-hara, Japan) et al. IN: *International Symposium on Space Technology and Science*, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1929-1934. refs

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NASA-JPL and Japan's Institute of Space and Astronautical Science collaborated at the Usuda Deep Space Center in the Voyager-2 Neptune occultation experiment. Phase information is extracted from the recorded data by means of a digital filter that can track the carrier frequency and narrow the filter bandwidth by up to 3 MHz. The results thus obtained can verify the phase-stability of the receiving system as a whole. Problems experienced by low-noise amplifiers were solved through the use of system redundancies. O.C.

A92-53723

ANALYSIS OF VOYAGER-NEPTUNE RADIO SCIENCE DATA ACQUIRED WITH USUDA ANTENNA

EI-ICHI MIZUNO (Kanazawa University, Japan), NOBUKI KAWASHIMA, KO-ICHIRO OYAMA, TADASHI TAKANO, SUSUMU SASAKI, ZEN-ICHI YAMAMOTO, JUN-ICHI HARUYAMA, and GAKU TORIYAMA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: *International Symposium on Space Technology and Science*, 17th, Tokyo, Japan, May 20-25, 1990, Proceedings. Vol. 2. Tokyo, AGNE Publishing, Inc., 1990, p. 1935-1940. refs

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Thirteen centimeter wavelength (λ) radio science data was collected during the Voyager Neptune occultation experiment on August 25, 1989 using the 64 m tracking antenna located in Usuda, Japan, and digitally recorded on magnetic tapes in real time. Data was also acquired using the 70 m antenna at Canberra, Australia (13 and 3.6 cm (λ)), and the 64-m antenna at Parkes, Australia (3.6 cm (λ)). Usuda 13-cm (λ) data are used to compute a temperature-pressure profile of the atmosphere of Neptune for the pressure level between about 1 mbar and about 2 bars. This is the first attempt to compute a profile using 13 cm (λ) data. By comparing it with 3.6 cm (λ) results which had already been computed, it is found that they have almost the same temperature of about 50 K at the tropopause, although in the upper atmosphere, they differ significantly. Author

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N92-29072*# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

PLANET-B: A JAPANESE MARS AERONOMY OBSERVER

K. TSURUDA /In Lunar and Planetary Inst., Workshop on the Martian Surface and Atmosphere Through Time p 161 1992
Avail: CASI HC A01/MF A03

An introduction is given to a Japanese Mars mission (Planet-B) which is being planned at the Institute of Space and Astronautical Science (ISAS), Japan. Planet-B aims to study the upper atmosphere of Mars and its interaction with the solar wind. The launch of Planet-B is planned for 1996 on a new launcher, M-L, which is being developed at ISAS. In addition to the interaction with the solar wind, the structure of the Martian upper atmosphere is thought to be controlled by the meteorological condition in the lower atmosphere. The orbit of Planet-B was chosen so that it will pass two important regions, the region where the solar wind interacts with the Martian upper atmosphere and the tail region where ion acceleration is taking place. Considering the drag due to the Martian atmosphere, the periaresis altitude of 150 km and apoapsis of 10 Martian radii are planned. The orbit plane will be nearly parallel to the ecliptic plane. The altitude of the spacecraft will be spin stabilized and its spin axis will be controlled to the point of the earth. The dry weight of the spacecraft will be about 250 kg, including the scientific payload which consists of a magnetometer, plasma instruments, HF sounder, UV imaging spectrometer, and lower atmosphere monitor. Author

N92-33753# National Space Development Agency, Tokyo (Japan).

FUTURE SPACE ACTIVITIES WORKSHOP: LUNAR BASE WORKSHOP 1991 [SHOURAI NO UCHUU KATSUDOU WAKUSHOPPU: GETSUMENKICHI WAKUSHOPPU 1991]

17 Jul. 1991 844 p In JAPANESE Workshop held in Ibaraki, Japan, 17-19 Jul. 1991
(JTN-92-80387) Avail: CASI HC A99/MF A10

Proceedings from the conference are presented in vewigraph form. The following topics were discussed: manned space activity, manned service platforms, life support system, space shower, Japanese space programs, Mars explorations, Mars observation satellites, atmospheric reentry, Mars landing and exploration missions, scientific exploration vehicles, sample return missions, International Asteroid Mission, lunar explorations, lunar soft landing, lunar module, lunar surface vehicles, manned lunar surface sites, lunar surface robots, lunar base construction, nuclear power plants, solar power generation, space transportation systems, fly-back boosters, international cooperation, miniaturizing artificial satellites, and space manufacturing.

Author (NASDA)

N92-33761# Nissan Motor Co. Ltd., Tokyo (Japan).

MARS EXPLORATION MISSION [KASEI TANSU MISSHON]

SEIJI MATSUDA /In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

Mars exploration scenarios are reviewed. An emphasis is placed on scientific exploration. The review and evaluation results are reported for the following items: (1) orbit plans for Mars surface exploration missions that begin in Low Earth Orbit (LEO); (2) powered and aerodynamic capturing payloads from the transfer orbit to a Mars revolving orbit; and (3) a penetrator system as a Mars landing vehicle. Proposed Mars transfer orbits have the following advantages over Hohmann orbits: (1) transfer time and angle are less; (2) the inclination between the orbital planes of Earth and Mars is considered; and (3) velocity variations are not required to change orbit plane. Author (NASDA)

N92-33762# Nippon Electric Co. Ltd., Tokyo (Japan).

MARS REVOLVING OBSERVATION SATELLITE [KASEI SHUUKAI KANSOKU EISEI]

TSUYOSHI OKAZAKI, TOORU NAKANO (Nippon Electric Co. Ltd., Japan), and MASABUMI INOMATA (Nippon Electric Co. Ltd., Japan) /In NASDA, Future Space Activities Workshop: Lunar

Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

The features that will be considered for observation on Mars are reviewed. The mission requirements, which are dictated by the features, are discussed. The mission scenarios assume the utilization of the H-2 launch vehicle. Additionally, spacecraft system structures are reviewed. Features that will be considered for observation by Mars satellites are as follows: (1) topographical and geographical features of the Mars surface; (2) material compositions and mineral resources on the Mars surface; (3) composition, pressure, and water vapor content of the Mars atmosphere; (4) vertical structure of the Mars atmosphere; and (5) the climate on Mars (clouds, polarcaps, and sand dusts). Mission operational requirements for exploration vehicle configurations (Mars-oriented and Earth-oriented), including mission equipment installation, onboard data processing, communication, attitude control, electric power source, and solar paddle systems, are reviewed. It is concluded that the Earth-oriented configuration is suitable for high-resolution local topography missions and the Mars-oriented configuration is suitable for atmospheric observation of the Martian surface. Author (NASDA)

N92-33764# Toshiba Corp., Tokyo (Japan).

MARS LANDING EXPLORATION MISSION [KASEI CHAKURIKU TANSU MISSHON]

MEGUMI SUZAKI /In NASDA, Future Space Activities Workshop: Lunar base Workshop 1991 p 22 17 Jul. 1991 In JAPANESE
Avail: CASI HC A03/MF A10

The overall concept for Mars observation missions and the systems to implement the missions are reviewed. Reviews are conducted on the following items: (1) profiles of the candidate missions; (2) aerodynamic capture deceleration estimates; (3) prospective Mars orbit decisions; (4) landing methods as the prerequisites for mission accomplishment; and (5) explorer systems to accomplish the missions. The major processes involved in the mission, from the launch to the beginning of observation of the surface, are outlined. Reviews of possible orbits taken by the explorer from Mars transfer orbit (Hohmann orbit) to Mars revolving orbit are presented. Additionally, the possible orbits for the landing vehicle from departing from the revolving orbit through landing are presented. Transportation and landing module design concepts concerning the structure, weight, and electric power balances of the explorer system are presented. Critical Mars mission technologies are cited as follows: (1) inter-planet navigation; (2) aerodynamic capture; (3) automatic and autonomous operation; and (4) landing technology. Author (NASDA)

N92-33765# Tokyo Univ. (Japan).

FUNDAMENTAL RESEARCH ON MARS EXPLORATION USING SCIENTIFIC EXPLORATION ROVING VEHICLES [IDOU KAGAKU TANSU SHA O MOCHIITA KASEI TANSU NO KISO KENKYUU]

NOBUKI KAWASHIMA, ICHIROU NAKATANI, JUNICHIROU KAWAGUCHI, KOUICHIROU KOYAMA, NORIMI HASEGAWA, SHUZZOU KINKORI (Nippondenso Co., Kariya, Japan), MANJI SUZUKI (Nippondenso Co., Kariya, Japan), MASAKI KOJIMA (Nishimatsu Construction Co. Ltd., Tokyo, Japan), KENJI SAITOU (Nishimatsu Construction Co. Ltd., Tokyo, Japan), TSUGUO ADACHI (Nishimatsu Construction Co. Ltd., Tokyo, Japan) et al. /In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 10 p 17 Jul. 1991 In JAPANESE
Avail: CASI HC A02/MF A10

The following fundamental items concerning Mars scientific exploration roving vehicles are reviewed: (1) special technical aspects; (2) review subjects; (3) purpose of the exploration; (4) methods of underground exploration; (5) other possible methods of scientific exploration; and (6) roving vehicle configuration. Communication between roving vehicles and the Earth, and the stringent environments on Mars are addressed. The driving system, roving distance, and the automatic driving system of the rovers are also presented. Focus is on the underground survey of Mars to check the existence of water or organic substance. The exploration methods covered are as follows: (1) analysis of samples

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excavated by mechanical drilling; and (2) electromagnetic measurement or sounding using artificial or natural earthquakes in order to explore deeper underground areas where samples can not be obtained by mechanical drilling. Author (NASDA)

N92-33766# Nishimatsu Construction Co. Ltd., Tokyo (Japan).
MARS SCIENTIFIC EXPLORATION ROVING VEHICLES AND DRILLING EQUIPMENT [KASEI IDOU KAGAKU TANSU SHA TO KUSSAKU SOUCHI]
KENJI SAITOU, MASAKI KOJIMA, SHUZO KINKORI (Nippondenso Co., Kariya, Japan), MANJI SUZUKI (Nippondenso Co., Kariya, Japan), NOBUKI KAWASHIMA (Tokyo Univ., Japan), and ICHIROU NAKATANI (Tokyo Univ., Japan) *In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE*
Avail: CASI HC A03/MF A10

Running gears for the Mars scientific exploration roving vehicles and the drilling equipment for the vehicles used to conduct underground exploration are studied. Review results on moving, driving, and running system for the vehicle are presented. For the driving system, comparison between conventional wheel system and crawler system are shown in a comprehensive table, and measures for failures are suggested. As for the development of the drilling equipment, the following items are presented: (1) methods of underground exploration; (2) methods of drilling (core boring and auger boring); (3) specifications for and the results of trial production of the experimental boring machine; (4) results of experimental boring machine operation on a simulated Mars surface; and (5) excavating capability of the experimental boring machine. Author (NASDA)

N92-33767# Toshiba Corp., Tokyo (Japan).
REVIEW ON PHOBOS SAMPLE RETRIEVAL MISSION [FOBOSU SANPURU KAISHUU MISSION NO KENTOU]
NOBUAKI NAGAOKA *In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 22 p 17 Jul. 1991 In JAPANESE*
Avail: CASI HC A03/MF A10

The purpose of the Phobos sample collection mission is to rendezvous with the Mars satellite Phobos, conduct observation of its surface, and collect and return samples to the Earth. The sample return satellite for achieving the mission will be injected into the Mars revolving orbit by a H-2 launch vehicle and an Orbit Transfer Vehicle (OTV). The satellite will stay on the Phobos surface till the Earth and Mars are in favorable positions relative to each other. Reviews are conducted on the following items: (1) onboard mission equipment; (2) the mission profile of injection into the revolving orbit of Mars, access to and landing on Phobos, and sample return to the Earth; (3) methods of fixing the satellite on the surface of Phobos; and (4) sample retrieving to the Earth. The following subsystems of the satellite system are reviewed: (1) the electric power subsystem; (2) the data processing communication subsystem; (3) the attitude and orbit control subsystem; (4) the propulsion subsystem; (5) the thermal control subsystem; (6) the structure subsystem; (7) the sample retrieving probe; and (8) the satellite configuration. Author (NASDA)

N92-33768# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
INTERNATIONAL ASTEROID MISSION (IAM) [IAM (INTANASHONARU ASUTEROIDO MISSION) NI TSUITE]
RYUJI YAMAGUCHI *In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE*
Avail: CASI HC A03/MF A10

International Asteroid Mission (IAM) is a program aimed at developing resources of asteroids abundantly existing near the earth. This report describes the research results of design project of the International Space University (ISU) held in 1990 at Tront-York University. ISU research and asteroid survey results, and the manned asteroid mining mission are outlined. Classification of asteroids existing near the earth and asteroid resource processing and use analyses are conducted. Asteroid selection flow charts are introduced, and the 1982HR-Orpheus is selected

as a candidate asteroid because it takes an approaching orbit toward the earth, requires small delta V, and possesses abundant carbonaceous chondrites. Characteristics of 1982HR-Orpheus are presented. Mission requirements, mission outlines, transportation systems, and mining and processing systems for manned asteroid mining missions are presented. Author (NASDA)

N92-33769# National Space Development Agency, Tokyo (Japan).
REVIEW ON UNMANNED LUNAR EXPLORATION MISSION [MUJIN TSUKI TANSU MISSION NO KENTOU]
YUTAKA KANEKO *In its Future Space Activities Workshop: Lunar Base Workshop 1991 26 p 17 Jul. 1991 In JAPANESE*
Avail: CASI HC A03/MF A10

Advance survey by unmanned exploration using robots is mandatory for the future manned lunar surface activities to be accomplished more safely and at a lower cost. Reviews are conducted on the following spacecraft to implement such unmanned mission by the Launch Vehicle and Satellite System Laboratory in Tsukuba Space Center: (1) moon revolving observation satellites; (2) lunar roving vehicles; (3) lunar hoppers; (4) a sample retrieval system; (5) a lunar landing module; and (6) lunar data relay satellites. Spacecraft involved in unmanned lunar exploration missions are outlined. Major characteristics and system structure of the lunar landing module are presented. The major feature, weight and electric power balances of the lunar roving vehicles, system configuration, structure, weight, electric power balances, flight paths, and major characteristics of lunar hoppers are also presented. System structure and weight estimates are indicated. Author (NASDA)

N92-33770# Nissan Motor Co. Ltd., Tokyo (Japan).
LUNAR EXPLORATION MISSION [TSUKI TANSU MISSION]
YUUKO NISHIO *In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 18 p 17 Jul. 1991 In JAPANESE*
Avail: CASI HC A03/MF A10

Manned lunar surface sites for manned missions, and lunar landing modules and roving vehicles for unmanned missions are reviewed. System requirements for lunar surface sites and their system structures are presented. Prerequisites and mission review results, landing orbits, thruster thrust, necessary delta V, and weight and electric power balances of the landing module are presented. The research and development elements for lunar landing modules are: (1) landing guidance technology; (2) development of landing gears; and (3) propulsion systems for landing. The missions, system review results, operation methods, and operation concepts of lunar roving vehicles are indicated. Research and development elements for lunar roving vehicles are: (1) running system (including wheels); (2) remote operation; and (3) autonomous driving technology. Author (NASDA)

N92-33771# Mitsubishi Space Software Corp. (Japan).
LUNAR SOFT LANDING ORBIT DESIGN [TSUKI NANCHAKURIKU KIDOU SEKKEI]
KEN NAKAJIMA and KOUTAROU NAGANO *In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 21 p 17 Jul. 1991 In JAPANESE*
Avail: CASI HC A03/MF A10

The following subjects necessary for lunar soft landing orbit design are reviewed: (1) methods to solve minimum fuel consumption problems; (2) lunar soft landing orbit design based on the results of the fuel consumption problems; and (3) future problems. The answer to the minimum fuel consumption by Pontryagin's maximum principle are presented. Lunar soft landing orbit design using a spherical model are presented for four assumed cases. Powered descending time-altitude profile, transient angle-altitude profile, powered descending time-vertical speed profile, powered descending time-control angle profile, and powered descending time-speed profile in down-range direction are showed. The following has become clear: (1) when powered descent begins from an elliptical orbit, starting from the perigee point is advantageous if the speed increase necessary for landing is

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employed as the criteria; and (2) constant thrust acceleration level exists to minimize necessary speed increase. Author (NASDA)

N92-33772# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).

REVIEW ON UNMANNED LUNAR LANDING MODULES LIFTED OFF BY H-2 LAUNCH VEHICLES [H-2 NI YORU MUJIN GETSUMEN CHAKURIKU KI NO KENTOU]

SHUNICHIROU NAKAI, TETSUYA NAKAMURA, YUKIHIITO KITAZAWA, and KAZUYUKI HIGASHINO /in NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 19 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

A review is conducted on unmanned lunar landing modules lifted off by H-2 launch vehicles to accomplish various missions on the lunar surface as the lead to manned lunar exploration. Results of mission trade-offs are presented, based on the assumption of conducting at least each one mission with and without roving vehicles, and one sample return mission, if possible. Detailed mission trade-offs for environment, geology, underground structure, and ground characteristic survey missions are presented, and an unmanned lunar landing module mission structure is exemplified. Operation plans up to arrival at the moon and after the arrival are introduced. Results of system reviews on operation plans, system structures, system function distributions, and subsystem reviews on propulsion, structures, thermal control, electric power, navigation, and guidance subsystems are presented. Reviews on configurations and development plans are also presented. Author (NASDA)

N92-33773# Hitachi Ltd., Tokyo (Japan).

CONCEPTUAL DESIGN OF LUNAR LANDING MODULE [GETSUMEN CHAKURIKU KI NO GAINEN SEKKEI]

TAKESHI KAWAZOE, TOSHIYUKI TANAKA, KOUHEI KATOU, KAZUHISA KANEKO, and MASAYA YAMAMOTO /in NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 23 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

Analyses on mission operations and systems for lunar landing modules are conducted. The results of the review are presented. The main subjects of the review are as follows: (1) mission operation analyses (orbits); (2) attitudes; (3) methods of detecting the barrier at landing; (4) stability at landing; (5) system configurations, weight, and power balances; (6) main propulsion system thrust and speed increments; (7) weight and electric power analyses; (8) thermal analyses; (9) communication circuits; (10) payload interfaces; (11) on-ground systems; (12) assembly methods; and (13) subsystems. Sequences up to landing on the moon are introduced as follows: (1) launch to lunar transfer orbit; (2) mid-course maneuver; (3) entry into lunar gravity range; (4) deceleration before entering lunar rotating orbit; (5) getting on the lunar rotating orbit; (6) descending maneuvering to land on the moon; (7) getting on the lunar descending orbit; (8) throttling to hovering thrust; (9) hovering at an altitude of 100 km; and (10) stopping the engine to land on the moon at an altitude of several meters. Author (NASDA)

N92-33774# Toshiba Corp., Kawasaki (Japan). Komukai Works.

MISSIONS AND SYSTEMS FOR LUNAR ROVING VEHICLES [GETSUMEN IDOU TANSU KI NO MISSION TO SHISUTEMU]

HIROSHI TOMITA /in NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 14 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

Studies on missions and systems of lunar roving vehicles are conducted to compensate for the defects of unmanned lunar landing modules. Results of the reviews on system requirements, exploration scenarios, and outlines of their operations are presented. The results of system reviews on navigation and guidance, and communication and lunar data relay satellites are introduced. Outlooks of mission equipment, candidate exploration courses, visible conditions, and exploration activities profiles are presented. Configuration, functional chart, GN&C (Guidance,

Navigation and Control) functional requirements of lunar roving vehicle, and lunar data relay satellite configuration and their orbit are also introduced. Since lunar roving vehicle technology involves most of the technologies necessary for Japan's future space development such as lunar and planet exploration, remote control, and autonomous and intelligent robot technologies, it is hoped that the space development capability level will be developed rapidly. Author (NASDA)

N92-33775# Remote Sensing Technology Center, Tokyo (Japan).

REVIEW ON LUNAR EXPLORATION MISSIONS REQUIREMENTS Report No. 3 [TSUKI TANSU MISSION YOUKYUU NO KENTOU]

HAJIME KOSHIISHI and NATSUHIKO MOTOMURA /in NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 17 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

A detailed review is conducted on the observation specifications of remote sensors and related items required for lunar remote sensing missions. Observation objectives, equipment specifications, combination, and expected observation results for the following sensors are presented: (1) a fluorescent x-ray spectrometer; (2) a gamma ray spectrometer; (3) a mapping camera and telephotocamera; (4) a high-resolution stereocamera; (5) an ultraviolet, visible, and short wavelength infrared imaging spectrometer; (6) a thermal infrared radiometer and spectrometer; (7) a microwave radiometer; (8) a synthetic aperture radar; (9) a laser altimeter; and (10) a magnetometer. As related items, relay satellites and radio source on lunar surface are introduced. Recent foreign trends in exploration of the Moon, Venus, Mars, asteroids, Jupiter, and Saturn and equipment necessary for those missions are also reviewed. Author (NASDA)

N92-33776# National Space Development Agency, Tokyo (Japan).

EXPERIMENT CONCEPTS AT MANNED LUNAR SURFACE SITES [YUJIN GETSUMEN KYOTEN NI OKERU JIKKEN GAINEN]

TSUTOMU IWATA /in its Future Space Activities Workshop: Lunar Base Workshop 1991 5 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A01/MF A10

The purpose of manned lunar surface sites is to experiment the feasibility of human activities on the lunar surface. The experiments will be conducted by three crews staying for ten day intervals in the module to verify habitation technology on the moon, to study scientific researches, and to research the development and utilization technologies of lunar surface. It is necessary to include the following elements in the experiments conducted on the manned lunar surface sites: (1) safe human shuttling to the lunar surface; (2) more than a ten day stay by people; (3) scientific exploration on lunar surface; (4) life science; (5) astronomical, space science, and physical experiments; (6) utilization experiments of lunar resources; and (7) construction technology experiments for lunar bases. Author (NASDA)

N92-33777# Mitsubishi Electric Corp., Tokyo (Japan).

PROCEDURES FOR INITIAL SETTING UP MANNED LUNAR SURFACE SITES [YUJIN GETSUMEN KYOTEN NO SHOKI TACHIAGE TEJUN NI TSUITE]

KATSUTOSHI OOMURA /in NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 13 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

Ideas to solve technical problems in constructing manned lunar surface sites such as energy supply, cartography of an accurate lunar surface map, connecting techniques of lunar modules, problem of life support, and standardization of OTV (Orbit Transfer Vehicle) and lunar landing modules are described. As a countermeasure for energy supply and lunar map cartography, the initial installation of large scale energy module and lunar roving vehicle ('lunar bulldozer') on the site are proposed respectively. For connecting lunar modules, the technology seems to be

available to make a moving attachment to the lunar modules. For the life support problem, it seems to be useful to apply life support system and environmental control techniques for closed environment on the earth.

Author (NASDA)

N92-33781# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).

LUNAR SURFACE EXPERIMENT PLANS [GETSUMEN JIKKEN KEIKAKU]

SEIKO HOSHI, MASAKAZU TAKAMI, and KEIKO YASUDA / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 20 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

A conceptual study is conducted on selection of experiment missions and lunar surface experiment systems to conduct scientific experiments at manned lunar surface sites, which are regarded as advance posts for verifying the feasibility of human activities and lunar resource utilization. The 22 lunar surface experiment model missions selected from the whole space utilization missions are roughly classified as follows: (1) lunar exploration mission; (2) life science mission; (3) material production mission; (4) 1/6 g mission; (5) high-vacuum application mission; (6) astronomical observation mission; and (7) radiation environment utilization mission. The results of the system review on experiment site locations, pressurized environmental testing system, lunar surface experiment systems (nearby module experiment section and remote spot experiment section), system resource analyses and operation are outlined. Interfaces between lunar surface experiment system and subsystems constituting manned lunar surface sites, material experiment flow chart of pressurized environment experiment system, nearby module experiment and remote spot experiment sections, resource analysis and technical problems in developing lunar surface experiment systems are presented.

Author (NASDA)

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STUDY COMMITTEE ON LUNAR BASES AND LUNAR RESOURCE DEVELOPMENT: RESULTS AND SUBJECTS [GETSUMEN KICHI TO TSUKI SHIGEN KAIHATSU KENKYUU KAI NI TSUITE: SEIKA TO KADAI]

HIROO HIEDA / In NASDA, Future Space Activities Workshop: Lunar Base Workshop 1991 13 p 17 Jul. 1991 In JAPANESE

Avail: CASI HC A03/MF A10

Study on lunar bases and lunar resource development is conducted by a committee which consists of more than 200 researchers. Results of the study are outlined on the following subjects: (1) fundamental reviews of the study; (2) establishment of research concepts; (3) fundamental reviews of space resource utilization; (4) reviews of lunar surface development and space theory; (5) phased development of lunar bases; (6) phased development of lunar activities and detail of activities in each phase; (7) major technologies required for lunar base construction; (8) conceptual design of D-He-3 nuclear reactors; (9) roles played by lunar bases in Mars exploration; and (10) ground test equipment. The results are summarized as follows: (1) practical scenarios of lunar base realization are shown and the feasibility of initial-stage manned lunar base with Japanese technology is made clear; (2) feasibility of visible radiation interferometer (lunar astronomical observatory) with a resolution of 1/100,000 second can be made clear; (3) major research and development problems on core technologies indispensable to construct lunar bases such as closed ecological life support system, robot, space transportation, and energy supply technologies; (4) existence of lunar resources such as D-He-3, solar wind gas, and metals and problems required for utilizing those resources are made clear; (5) it is shown that D-He-3 nuclear fusion has higher economy, safety, and environment maintainability than D-He-3 laser nuclear fusion; and (6) test equipment which should be subjected to rapid start for constructing lunar bases is identified.

Author (NASDA)

92

SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

A92-10738

SOLAR WIND NEAR THE SUN OBSERVED WITH INTERPLANETARY SCINTILLATION USING THREE MICROWAVE FREQUENCIES

MUNETOSHI TOKUMARU (Hiraiso Solar Terrestrial Research Center, Nakaminato, Japan), HIROTAKA MORI, TAKASHI TANAKA (Communications Research Laboratory, Koganei, Japan), TETSURO KONDO, HIROSHI TAKABA, and YASUHIRO KOYAMA (Communications Research Laboratory, Kashima, Japan) Journal of Geomagnetism and Geoelectricity (ISSN 0022-1392), vol. 43, no. 8, 1991, p. 619-630. refs

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Interplanetary scintillation observations with a large antenna system are carried out at 2, 8 and 22 GHz to investigate the solar wind near the sun. The solar wind velocities estimated by fitting the theoretical model for IPS spectra indicate that the solar wind is markedly driven at distances between 10 and 30 solar radii. The derived scintillation indices show a good agreement with a radial dependence of $R \exp -1.6$ for more than 5 solar radii, and also display a slight enhancement around the region where the solar wind acceleration occurs. The latter fact implies that plasma fluctuations are enhanced in the acceleration region.

Author

A92-10743

QUIESCENCE OF GLE-PRODUCIBLE SOLAR PROTON ERUPTIONS DURING THE TRANSITION PHASE OF HELIOMAGNETIC POLARITY REVERSAL NEAR THE SOLAR-ACTIVITY-MAXIMUM PERIOD

KAZUO NAGASHIMA, SHIZUKO SAKAKIBARA (Nagoya University, Japan), and ISAO MORISHITA (Asahi University, Motosu, Japan) Journal of Geomagnetism and Geoelectricity (ISSN 0022-1392), vol. 43, no. 8, 1991, p. 685-689. refs

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A92-11614

CA II K LINE ASYMMETRIES IN TWO WELL-OBSERVED SOLAR FLARES OF OCTOBER 18, 1990

C. FANG (National Astronomical Observatory, Mitaka, Japan; Nanjing University, People's Republic of China), E. HIEI, and T. OKAMOTO (National Astronomical Observatory, Mitaka, Japan) Solar Physics (ISSN 0038-0938), vol. 135, Sept. 1991, p. 89-97. refs

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Two-dimensional evolutions of two flares of October 18, 1990 have been well observed in the Ca II K line with a CCD camera at Norikura station of National Astronomical Observatory in Japan. There are two common characteristics for the flares: 3 - 5 min before the impulsive phase, the heating already begins at the footpoints of the flares, but no asymmetry in line emission has been detected. After the onset of the impulsive phase, Ca II K line emission at the footpoints shows strong red asymmetry, with the maximum asymmetry occurring at the same time as the peak of the radio bursts. The maximum downward velocity is about 30-50 km/s. For flare 1, blue and red asymmetries were observed in two sides of the footpoint area. They developed and attained a maximum nearly at the same time and the inferred Doppler velocities are comparable (30-40 km/s). This implies that two mass jets started from a small region and ejected along a loop but in opposite directions with roughly equivalent momentum. A possible mechanism has been discussed.

Author

A92-12681* Kyoto Univ. (Japan).

NUMERICAL SIMULATIONS OF MICROFLARE EVOLUTION IN THE SOLAR TRANSITION REGION AND CORONA

ALPHONSE C. STERLING (Kyoto University, Japan), JOHN T.

MARISKA (U.S. Navy, E.O. Hulburt Center for Space Research, Washington, DC), KAZUNARI SHIBATA (Aichi University of Education, Kariya, Japan), and YOSHINORI SUEMATSU (National Astronomical Observatory, Mitaka, Japan) *Astrophysical Journal*, Part 1 (ISSN 0004-637X), vol. 381, Nov. 1, 1991, p. 313-322. Research supported by U.S. Navy and NASA. refs
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Several observers report transient ultraviolet brightenings, often referred to as microflares, in the solar atmosphere. In this paper, the results are presented of a series of one-dimensional numerical simulations examining possible relationships between microflares and the generation of dynamical chromospheric and transition region features. Low-energy and medium-energy microflares eject long-lived cool, dense gas plugs into the corona, with the gas plug traversing the loop apex in the medium energy case. In the case of high-energy microflares, the gas plug is rapidly heated to the temperature of the surrounding corona, and the results resemble the dynamics occurring in standard solar flare thick-target electron beam models. Author

A92-17476

EMISSION LINES IN THE SPECTRA OF THE 3B FLARE OF SEPTEMBER 19, 1979

CHENG FANG (National Astronomical Observatory, Mitaka, Japan; Nanjing University, People's Republic of China), TOMIZO OKAMOTO, and EIJIRO HIEI (Japan, National Astronomical Observatory, Publications (ISSN 0915-3640), vol. 2, no. 2, 1991, p. 173-183. refs

Attention is given to the spectra of a 3B flare of September 19, 1979, in the wavelength region from 3590 to 3990 Å, observed at the 25 cm coronagraph of the Norikura Solar Observatory. Many emission lines as well as continuum emission appeared in the spectra. An atlas of the excess spectrum at the maximum phase of the flare, which was derived by subtracting the nearby spectrum of the undisturbed penumbra, was given in the absolute scale of intensity. A complete list of flare emission lines, including the absolute intensity at the center of each line, is also given. The total number of the emission lines is 331. An atlas of the excess spectrum near the maximum phase of the flare in the wavelength region from 3590 to 3990 Å is provided. P.D.

A92-19446

PLASMA WAVES CAUSED BY TRANSIENT HEAT CONDUCTION IN A CORONAL LOOP AND ANOMALOUS RESISTIVITY

T. TAKAKURA (Tokyo, University, Japan) *Solar Physics* (ISSN 0038-0938), vol. 136, Dec. 1991, p. 303-316. refs
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Numerical simulation is made of the transient heat conduction during local heating in a model coronal magnetic loop with an axial electric current. It is assumed that a segment near the top of the normal coronal loop is heated to above $10 \exp 7$ K by a sufficiently small heat input as compared with the total flare energy. A hump appears in the velocity distribution of electrons moving down the temperature gradient with speeds slightly below the thermal one. Consequently, electron plasma waves are excited. The high intensity of the waves persists in the upper region of the loop for more than a second until the termination of the simulation. The energy density of the plasma waves normalized with respect to thermal density is $10 \exp -3.5$ at maximum. A theoretical estimate gives an anomalous resistivity five orders of magnitude greater than an initial value. Based on the above result, a model for impulsive loop flares is proposed. Author

A92-20708

EMERGENCE OF MAGNETIC FLUX FROM THE CONVECTION ZONE INTO THE SOLAR ATMOSPHERE. I - LINEAR AND NONLINEAR ADIABATIC EVOLUTION OF THE CONVECTIVE-PARKER INSTABILITY

S. NOZAWA (Aichi University of Education, Kariya; Nagoya University, Toyokawa, Japan), K. SHIBATA (Aichi University of Education, Kariya, Japan), R. MATSUMOTO (Chiba University, Japan), A. C. STERLING (Kyoto University, Japan), T. TAJIMA

(Texas, University, Austin), Y. UCHIDA (Tokyo, University, Japan), A. FERRARI (Torino, Università, Turin, Italy), and R. ROSNER (Chicago, University, IL) *Astrophysical Journal Supplement Series* (ISSN 0067-0049), vol. 78, Jan. 1992, p. 267-282. Research supported by Japan Society for Promotion of Science. refs
(Contract MOESC-01740143)
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The linear and nonlinear properties of the evolution of emerging magnetic flux from the solar convection zone into the photosphere, chromosphere, and corona are studied. A linear stability analysis of the partially magnetized convection zone is presented. The growth rate of this combined convective-Parker instability is found to differ significantly from that of the Parker instability in the absence of convection. When $\beta (=p_g/p_m)$ is greater than 10 in the initial flux sheet, the growth rate increases with horizontal wavenumber, and there is no maximum growth rate. A local maximum can occur when the flux is initially located near the top of the convection zone. When β is less than 10, the convective-Parker instability behaves like the Parker instability for long-wavelength modes, and like the convective instability for short-wavelength modes. A 2D MHD code is used to study the nonlinear evolution of the system. When the initial flux sheet has β less than 10, the long-wavelength mode dominates the nonlinear evolution of the system, independently of the initial perturbation wavelength. P.D.

A92-25063

THE CURRENT SHEET AND JOULE HEATING OF A SLENDER MAGNETIC TUBE IN THE UPPER PHOTOSPHERE

T. HIRAYAMA (National Astronomical Observatory, Mitaka, Japan) *Solar Physics* (ISSN 0038-0938), vol. 137, Jan. 1992, p. 33-50. refs

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Joule heating in a slender magnetic flux tube is investigated. To ensure the mass flux conservation, an overshooting convective flow pattern resembling recent simulations was assumed. Even with the electrical resistivity from neutral hydrogen, the width of the current sheet was found to be about 2 km, being much smaller than the tube diameter of about 150 km, either from an exact or approximate (Gaussian) field distribution. The resultant energy flux density due to Joule heating averaged over the cylindrical cross sectional area is about $1 \times 10 \exp 9$ erg/sq cm per sec for an assumed photospheric magnetic field of 1500 G. This amount may supply enough energy to heat the temperature minimum region of the flux tube by $\Delta T = 300$ K in accord with observations, though the estimation of the excess radiation loss which should be supplied by the Joule heating to keep $\Delta T = 300$ K is rather uncertain. A possible role of the Joule heating on spicule formation is briefly discussed together with discussions on the slab geometry, general flow patterns, and nonconstant field distributions inside the flux tube. Author

A92-27285

A THEORY OF FILAMENT ERUPTIONS BEFORE THE IMPULSIVE PHASE OF SOLAR FLARES

JUN-ICHI SAKAI and SHINJI KOIDE (Toyama University, Japan) *Solar Physics* (ISSN 0038-0938), vol. 137, Feb. 1992, p. 293-306. refs

(Contract MOESC-03640247)

Copyright

A theory of filament eruption before the impulsive phase of solar flares is presented. It is shown that the upward motion of the magnetic X-point tracing the filament eruption begins several minutes before the impulsive phase of the flare, where the explosive magnetic reconnection starts at the X-point magnetic field configuration located under the filament. No change occurs in the character of the motion of the X-point during the onset of the explosive magnetic reconnection. The upward speed of the X-point is about 110 km/s at the onset of the impulsive phase. An important condition leading to filament eruptions is given which relate to the state of the current sheet under the filament, where the magnetic energy can be released. Author

A92-28098

DECAY INSTABILITY OF INCOHERENT ALFVEN WAVES IN THE SOLAR WIND

H. UMEKI and T. TERASAWA (Kyoto University, Japan) *Journal of Geophysical Research* (ISSN 0148-0227), vol. 97, no. A3, March 1, 1992, p. 3113-3119. refs
(Contract MOESC-02640325)
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The nonlinear evolution of a large-amplitude incoherent Alfvén wave is studied via 1D magnetohydrodynamic simulation. The initial wave magnetic field is given as a superposition of circularly polarized Alfvén waves with the same helicity and propagation direction but with different wave numbers. What is observed is contrary to the previous belief that incoherent Alfvén waves are stable against decay: in a low beta plasma ($\beta = 0.2$) the growth of backscattered Alfvén waves, which are opposite in helicity and propagation direction from the original Alfvén waves, can be clearly seen. In a high beta plasma ($\beta = 2.0$), on the other hand, no backscattered Alfvén waves are observed. These results are consistent with the expectation from the theory of the parametric decay instability developed for a coherent Alfvén wave. It is also shown that incoherent Alfvén waves in the solar wind can decay parametrically in the region of 4-20 RS where beta is sufficiently low. For the decay process to work, the period of Alfvén waves should be less than several minutes. Author

A92-30904

PROBLEMS OF SOLAR CONVECTION

WASABURO UNNO (Kinki University, Higashiosaka, Japan) IN: *Basic plasma processes on the sun*. Dordrecht, Netherlands, Kluwer Academic Publishers, 1990, p. 39-44; Discussion, p. 44. refs
Copyright

The characteristics of overshooting convection and the role of kinetic energy transport are discussed. Observed brightening of downflow at high levels in the solar surface region over intergranular lanes is found to be consistent with the overshooting model. Momentum transport by convective motion is shown to be crucial in pushing down magnetic flux tubes against buoyancy. It is argued that subadiabatic layers are formed temporarily in the middle of the convection zone, exciting oscillations and generating chaotic motions. C.A.B.

A92-44255

THE SUDDEN DISAPPEARANCE OF A DARK FILAMENT OBSERVED ON OCTOBER 26, 1989

JUN KUBOTA, REIZABURO KITAI (Kwasan and Hida Observatories, Kyoto, Japan), ICHIRO TOHMURA (Osaka Prefectural College of Technology, Neyagawa, Japan), and AKIRA UESUGI (Kyoto University, Japan) *Solar Physics* (ISSN 0038-0938), vol. 139, no. 1, May 1992, p. 65-79. refs
(Contract MOESC-01420002)
Copyright

H-alpha monochromatic and spectroscopic observations of the sudden disappearance of a dark filament located near the center of the solar disk on October 26, 1989 are presented. The event was not associated with the flare activity. The dark filament first disintegrated into two loop-like components, and then each component successively showed ascending motion within a velocity greater than 30 km/s. Comparison of the H-alpha pictures taken before and after the start of this event suggests that the dark filament was originally composed of two magnetic flux loops. Author

A92-47626

DEVELOPMENT OF A SOLAR FLARE PREDICTION SYSTEM WITH KNOWLEDGE ACQUISITION FUNCTION BASED ON MULTIVARIATE CLUSTER ANALYSIS METHOD

TAMOTSU SHIRADO *Communications Research Laboratory, Review* (ISSN 0914-9279), vol. 38, no. 1, March 1992, p. 1-14. In Japanese. refs
Copyright

This paper describes a prototype system for solar flare

prediction. This system is developed mainly to acquire prediction rules without help of expert on solar flare prediction. Learning-scheme is found out based on the multivariate cluster analysis. Author

A92-49465

PROMPT PARTICLE ACCELERATION AROUND MOVING X-POINT MAGNETIC FIELD DURING IMPULSIVE PHASE OF SOLAR FLARES

JUN-ICHI SAKAI (Toyama University, Japan) *Solar Physics* (ISSN 0038-0938), vol. 140, no. 1, July 1992, p. 99-119. refs
(Contract MOESC-03640247)
Copyright

A model is presented for high-energy solar flares to explain prompt proton and electron acceleration, which occurs around moving X-point magnetic fields during the implosion phase of the current sheet. The electromagnetic fields are calculated for the period during the strong implosion of the current sheet, which is driven by the converging flow toward the center of the magnetic arcade. A test particle motion in the strong electromagnetic fields derived from the MHD equations is studied. It is shown that both protons and electrons can be promptly (within 1 s) accelerated to about 70 and 200 MeV, respectively. This acceleration mechanism can be applicable for the impulsive phase of the gradual gamma-ray and proton flares (gradual GR/P flare), which have been called two-ribbon flares. Author

A92-54586

MAGNETIC RECONNECTION ASSOCIATED WITH EMERGING MAGNETIC FLUX

KAZUNARI SHIBATA (National Astronomical Observatory, Mitaka, Japan), SATOSHI NOZAWA (Nagoya University, Toyokawa, Japan), and RYOJI MATSUMOTO (Chiba University, Japan) *Astronomical Society of Japan, Publications* (ISSN 0004-6264), vol. 44, no. 3, 1992, p. 265-272. Research supported by Ishida Foundation. refs
(Contract MOESC-03302013)
Copyright

2D MHD numerical simulations have been performed in order to study magnetic reconnection between an emerging flux and an overlying coronal magnetic field, while taking into account the effect of gravity, high spatial resolution, and a sufficient time span. The reconnection starts when most of the chromospheric mass in the current sheet between the emerging flux and the coronal field has drained down along the loop due to gravity. This implies that the start of a compact flare, or an X-ray bright point, follows the disappearance of an arch filament. It is also found that multiple magnetic islands are created in the sheet, which confine a cool, dense chromospheric plasma. These islands dynamically coalesce with each other and are ejected along the sheet at the Alfvén speed. Author

N92-21948*# Toyama Univ. (Japan). Lab. for Plasma Astrophysics and Fusion Science.

PROMPT PARTICLE ACCELERATION AROUND MOVING X-POINT MAGNETIC FIELD DURING IMPULSIVE PHASE OF SOLAR FLARES

JUN-ICHI SAKAI In NASA. Goddard Space Flight Center, The Compton Observatory Science Workshop p 528-535 Feb. 1992 Sponsored in part by ELCO Company
(Contract ASR-ME-03640247)
Avail: CASI HC A02/MF A04

We present a model for high-energy solar flares to explain prompt proton and electron acceleration, which occurs around moving X-point magnetic field during the implosion phase of the current sheet. We derive the electromagnetic fields during the strong implosion phase of the current sheets, which is driven by the converging flow derived from the magnetohydrodynamic equations. It is shown that both protons and electrons can be promptly (within 1 second) accelerated to approximately 70 MeV and approximately 200 MeV, respectively. This acceleration mechanism can be applicable for the impulsive phase of the gradual

93 SPACE RADIATION

gamma ray and proton flares (gradual GR/P flare), which have been called two-ribbon flares. Author

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SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

A92-13452

TIME VARIATION OF THE COSMIC RAY MUON FLUX IN UNDERGROUND DETECTORS AND CORRELATION WITH ATMOSPHERIC TEMPERATURE

KAZUOKI MUNAKATA, TOMOHIRO TSUCHIDA, SHUJI SAGISAKA, MOTOYUKI SHIMADA, YUKIHIKO SUZUKI, MAKOTO FURUHATA, SHINICHI YASUE, SATORU MORI (Shinshu University, Matsumoto, Japan), MASAKI MORI, YUICHI OYAMA (National Laboratory for High Energy Physics, Ibaraki, Japan) et al. *Physical Society of Japan, Journal* (ISSN 0031-9015), vol. 60, Sept. 1991, p. 2808-2811. Research supported by MOESC, DOE, and University of Pennsylvania. refs Copyright

Time variations of the cosmic ray muon flux observed during the period of January 1987 - April 1990 in the Matsushiro Underground Muon Observatory and the Kamiokande-II detector are examined. A significant correlation between the two observations is found. This is considered to be the first positive correlation of precise measurements of the atmospheric temperature with observations at different experimental sites of the cosmic ray muon flux in both the 100 GeV and the TeV regions. O.G.

A92-18393

NATURE OF SOLAR-CYCLE AND HELIOMAGNETIC-POLARITY DEPENDENCE OF COSMIC RAYS, INFERRED FROM THEIR CORRELATION WITH HELIOMAGNETIC SPHERICAL SURFACE HARMONICS IN THE PERIOD 1976-1985

K. NAGASHIMA, K. FUJIMOTO (Nagoya University, Japan), and R. TATSUOKA (Chubu University, Kasugai, Japan) *Planetary and Space Science* (ISSN 0032-0633), vol. 39, Dec. 1991, p. 1617-1635. refs Copyright

The relationship between cosmic-ray intensity (I) and solar activity is examined to obtain a better correlation. The correlation is developed by incorporating several independent variables and assuming mutually independent time lags of I behind the variables. The regression equation is presented which shows that higher-order magnetic disturbances have longer durations than other disturbances. Lower-order magnetic disturbances are found to modulate cosmic rays more effectively than the higher-order ones. It is found to depend additionally on the solar polar magnetic field, and the notion is supported by observational evidence from the period from 1936-76 and by the 22-year variations of the time lags from every solar cycle. A diffusion-convection-drift model is employed in an attempt to describe the theoretical implications of the polarity dependences in terms of spherical surface harmonics. C.C.S.

A92-18394

GALACTIC COSMIC-RAY ANISOTROPY AND ITS HELIOSPHERIC MODULATION, INFERRED FROM THE SIDEREAL SEMIDIURNAL VARIATIONS OBSERVED IN THE RIGIDITY RANGE 300-600 GV WITH MULTIDIRECTIONAL MUON TELESCOPE AT SAKASHITA UNDERGROUND STATION

K. NAGASHIMA, K. FUJIMOTO (Nagoya University, Japan), and I. MORISHITA (Asahi University, Gifu, Japan) *Planetary and Space*

Science (ISSN 0032-0633), vol. 39, Dec. 1991, p. 1637-1655. refs

Copyright

The directions and magnitudes of the first- and second-order anisotropies are determined in a specific galactic cosmic-ray intensity distribution with data from 10 telescopes. The investigation is conducted with specific attention given to the geometric configuration of the telescopes, the influence of the cosmic rays' heliomagnetospheric modulation, the geomagnetic deflection, and the nuclear interaction with the earth. The first-order anisotropy is included since it can produce a semidiurnal variation due to heliospheric modulation. The magnitudes of the first- and second-order modulations are more than and less than zero, respectively, and have approximately the same direction. The anisotropy is expressed as an axis-symmetric loss-cone type and is compared to a similar expression for a previously observed anisotropy. C.C.S.

A92-22422

NEW DOORS OPENED BY THE POLAR PATROL BALLOON - COSMIC QUARK MATTER, MICROGRAINS AND GAMMA RAYS

Y. FUKADA, Y. HATANO, T. SAITO (Tokyo, University, Japan), R. FUJII (National Institute of Polar Research, Tokyo, Japan), H. ODA (Kobe University, Japan), and T. YANAGITA (Kansai Jyogakuin Junior College, Miki, Japan) *IN: Astrophysics in Antarctica. New York, American Institute of Physics, 1989, p. 176-179. refs Copyright*

A single Antarctic balloon flight furnishes the particle-collecting power of 100 sq m(x hours). Attention is presently given to the preliminary indications of prospective advantages from Antarctic balloonborne searches for quarks from neutron stars, the detection of high-energy micrograins and atoms in cosmic radiation, and observations of gamma rays at 1-1000 GeV energies. If anomalous particles are of cosmic origin, and if they are accelerated and propagated in the same way as cosmic rays, the anomalies will be detectable at lower energies by these means than by ground-based experiments. O.C.

A92-22423

SEARCH FOR ANTIMATTER AT THE 10 EXP -7 LEVEL WITH THE POLAR PATROL BALLOON

Y. FUKADA, Y. HATANO, T. SAITO (Tokyo, University, Japan), R. FUJII (National Institute of Polar Research, Tokyo, Japan), H. ODA (Kobe University, Japan), and I. YAMAMOTO (Okayama University of Science, Japan) *IN: Astrophysics in Antarctica. New York, American Institute of Physics, 1989, p. 180-183. refs Copyright*

An account is given of a novel particle-annihilation technique for antimatter research which will be used in Antarctic balloonborne experiments. The capacity for particle-antiparticle discrimination in the detector is about 10 exp -9, as a result of combining the 10 exp -5 sensitivity of the Cherenkov technique confirmed via accelerator antiproton beams, and the 10 exp -4 sensitivity of topological methods. The 0.25 sq m detector carried by a polar balloon flight will reach flux sensitivities of 10 exp -7 for antiprotons and antihelium, but only 10 exp -6 for heavier nuclei. O.C.

A92-24077

THE ON-ORBIT MEASUREMENTS OF SINGLE EVENT PHENOMENA BY ETS-V SPACECRAFT

T. GOKA (High-Reliability Components Corp., Tokyo, Japan), S. KUBOYAMA, Y. SHIMANO, and T. KAWANISHI (NASDA, Tsukuba, Japan) (1991 IEEE Annual Conference on Nuclear and Space Radiation Effects, 28th, San Diego, CA, July 15-19, 1991, Proceedings. A92-24025 08-33) *IEEE Transactions on Nuclear Science* (ISSN 0018-9499), vol. 38, pt. 1, Dec. 1991, p. 1693-1699. refs Copyright

The on-orbit data of single event phenomena were obtained for the CMOS static RAMs equipped in Engineering Test Satellite-V (ETS-V) in a geostationary orbit. The single event latchup and single event upset data were acquired for a period of about three

years, and the effects of solar flares were observed. A comparison with the data (single event upset) of TTL SRAMs by Marine Observation Satellite-1 (MOS-1: a medium-altitude satellite) was also conducted. The Poisson distribution and the extreme-value theory (doubly exponential distribution) were adopted to analyze the data. From this analysis a decrease of the number of single events could be found during the solar maximum. I.E.

A92-33877**A NEW DETECTION OF CYCLOTRON LINES SEEN IN A GAMMA-RAY BURST GB890929**

ATSUMASA YOSHIDA (Institute of Physical and Chemical Research, Wako, Japan), TOSHIO MURAKAMI, JUN NISHIMURA (Institute of Space and Astronautical Science, Sagami, Japan), ICHIRO KONDO (Shibaura Institute of Technology, Omiya, Japan), and EDWARD E. FENIMORE (Los Alamos National Laboratory, NM) Astronomical Society of Japan, Publications (ISSN 0004-6264), vol. 43, no. 6, 1991, p. L69-L75. Research sponsored by DOE. refs

Copyright

The Gamma-Ray Burst Detector on the Ginga satellite has observed new cyclotron line features in the spectra of a gamma-ray burst which occurred on 1989 September 29 (GB890929). A spectral analysis also showed double line features. The best-fit gave a cyclotron-energy of $EB = 24.1 \pm 0.9$ keV, which corresponds to a magnetic field of $B = (2.08 \pm 0.08) (1 + z) \times 10^{12}$ gauss, where z represents the gravitational redshift. The electron column density for the line-forming region is estimated to be $(1.8 \pm 0.5) \times 10^{21} \text{ cm}^{-2}$. These features were similar to those seen in the bursts previously observed with Ginga. So far, cyclotron features have been detected in three bursts out of 23 events of which Ginga measured reasonably significant spectra. Author

A92-44261**DETAILED COMPARISON BETWEEN SUNSPOT ACTIVITY IN 'HOT SPOTS' AND GALACTIC COSMIC-RAY INTENSITY**

M. AKIOKA, J. KUBOTA (Kwasan and Hida Observatories, Kyoto, Japan), M. SUZUKI (Kawagoe High School, Japan), and I. TOHMURA (Osaka Prefectural College of Technology, Neyagawa, Japan) Solar Physics (ISSN 0038-0938), vol. 139, no. 1, May 1992, p. 177-187. refs

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The influence of sunspot activity on the condition of the solar-terrestrial environment during cycle 21 was examined using the data of sunspots and the modulation of the galactic cosmic-ray intensity. The 'hot spots' discussed by Ichimoto et al. (1985) and Bai (1987, 1988) were also found by analyzing the longitudinal distribution of sunspot groups. A detailed comparison between the time change of the sunspot activity in hot spots and that of the galactic cosmic rays observed by the neutron monitor reveals that several transient diminutions of the GCR intensity (with much longer duration than a Forbush decrease) occur at nearly the same time as the sporadic enhancement of sunspot area in the hot spots. Author

A92-56660**LOCAL-TIME-DEPENDENT PRE-IMF-SHOCK DECREASE AND POST-SHOCK INCREASE OF COSMIC RAYS, PRODUCED RESPECTIVELY BY THEIR IMF-COLLIMATED OUTWARD AND INWARD FLOWS ACROSS THE SHOCK RESPONSIBLE FOR FORBUSH DECREASE**

K. NAGASHIMA, K. FUJIMOTO, S. SAKAKIBARA (Nagoya University, Japan), I. MORISHITA (Asahi University, Gifu, Japan), and R. TATSUOKA (Chubu University, Kasugai, Japan) Planetary and Space Science (ISSN 0032-0633), vol. 40, no. 8, Aug. 1992, p. 1109-1137. refs

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N92-12962*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

X RAY EMISSION FROM ACTIVE GALACTIC NUCLEI

RICHARD MUSHOTZKY In NAS-NRC, High-Energy Astrophysics. American and Soviet Perspectives p 297-306 1991

Avail: CASI HC A02/MF A04

There have recently been a large number of good reviews in this subject which have extensively covered the x-ray spectral and temporal properties of Seyfert galaxies and quasars in the 0.1-20 keV band. Rather than reviewing this material I concentrate on several observation issues which have been raised recently and some theoretical consequences. I also stress what the next year will bring from Ginga, Rosat, and BBXRT observations and re-analysis of Einstein data. Author

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GENERAL

A92-27750**TECHNOLOGICAL COMPETITION AND INTERDEPENDENCE - THE SEARCH FOR POLICY IN THE UNITED STATES, WEST GERMANY, AND JAPAN**

GUENTER HEIDUK, ED. (Universitaet Duisburg Gesamthochschule, Federal Republic of Germany) and KOZO YAMAMURA, ED. (Washington, University, Seattle) Seattle, WA and London/Tokyo, University of Washington Press/University of Tokyo Press, 1990, 277 p. No individual items are abstracted in this volume.

(ISBN 0-295-96931-8) Copyright

The present work discusses the current status of the U.S.'s postwar technological leadership, the current and prospective status of Japanese technological capabilities, perceptions as to Germany's technological capabilities in the 1980s, the effects of industrial structure on industrial policy, and a theory of international economic regimes. Also discussed are the relative effectiveness of conglomerates and keiretsu in fostering technological innovation, the German competitive position in the trade of technology-intensive products, prospects for U.S. leadership in high-tech industries, the changing character of competitive advantage in automobiles, and the benefits and burdens of technological leaders. O.C.

A92-55843**HISTORICAL ASPECTS OF SPACECRAFT TECHNOLOGY AND ITS DIFFUSION IN SOCIETY IN JAPAN**

H. MITSUMA (National Institute of Science and Technology Policy, Tokyo, Japan) IAF, International Astronautical Congress, 43rd, Washington, Aug. 28-Sept. 5, 1992. 10 p. refs

(IAF PAPER 92-0188) Copyright

Progress in general-purpose technologies resulting from and leading to aerospace technologies is examined with respect to the Japanese space programs. The history of national space programs is reviewed, and technological diffusion is described for satellite-related fields such as earth observation, communications, and space-environment experimentation. It is shown that many of the technologies have broad global applications and can bring substantial economic returns. C.C.S.

A92-57040**WHITE PAPER ON SCIENCE AND TECHNOLOGY 1991 - GLOBALIZATION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES AND ISSUES JAPAN IS ENCOUNTERING**

Tokyo, Japan Information Center of Science and Technology, 1992, 261 p. Translation.

(ISBN 4-88890-183-X) Copyright

The present volume on the globalization of scientific R&D examines the international rights and responsibilities of Japan with attention to its possible role in technological development. Specific attention is given to the promotion of global scientific and technological activities as well as 'internal globalization' by

99 GENERAL

advancing national research infrastructures and promoting exchanges with foreign scientists. R&D expenditures and other quantifiable measures are compared with those of other countries, and trends are identified in technology and patent applications. Japan's policy for science and technology is based on: (1) promoting creative sciences such as materials, space, and earth/life sciences; (2) encouraging the international aspect of R&D; and (3) developing science and technology areas that activate the economy and improve the quality of life. C.C.S.

N92-12987# New Energy Development Organization, Tokyo (Japan).

RESULTS AND THE FUTURE OF RESEARCH, PART 2 Annual Report, 1988

Sep. 1989 689 p In JAPANESE

(DE90-503494; NEDOJ-P-8902-2-PT-2) Avail: CASI (US Sales Only) HC A99/MF A06

This annual report is the second volume of the reports in 3 parts on the results and future aspect of the studies made up to last year. In regard to the development of solar energy technology, reports are made on; technological development for practical application of photovoltaic power generation and industrial solar systems; development of large scale wind power generation system; and technological cooperative promotion projects. As regards the development of fuel storage technology, there are reports on development of fuel cell power generation technology, development of new type battery electric power storage system, research and development of super heat-pump energy collection system, development of ceramic gas turbine technology, development of superconductive electric power application technology, etc. In connection with the development of alcoholic and biomass technologies, reports are made on the development of fuel alcohol technology, development of high performance methane gas separation and composite production technology, and demonstration test of methanol conversion at the petroleum thermoelectric power station. As to the development of other related technologies, demonstration tests for practicalization of separate type new power generation technology and centralized load control system are reported. DOE

N92-17623# Kyoto Univ., Kumatori (Japan). Research Reactor Inst.

SUMMARY REPORTS OF ACTIVITIES UNDER VISITING RESEARCH PROGRAM

Feb. 1991 69 p In JAPANESE

(DE91-522477; KURRI-TR-341) Avail: CASI HC A04/MF A01

The book carries a large number of summary studies made by using the Research Reactor (KUR) or the Critical Assembly (KUCA). These studies include: low temperature irradiation effect on iron-alloy and ceramics; the influence of the neutron irradiation on the low temperature strength of various welded joint of dissimilar materials; effects of neutron irradiation on superconducting properties under stress in superconducting wires; neutron activation analysis and photo-emission phenomena from gamma-ray irradiated rock-forming minerals; irradiation effects in nonmetallic conductors, distribution, and mobility of ions of metal elements in stem; activation analysis of high purity metals; Moessbauer spectroscopic studies of superionic conductor; neutron spectrometry with CR-39 track detector; geochemical study on trace element abundances in island arc igneous rocks; reactor rate distribution measurement of tight pitch lattice core with internal blanket; measurement of the foil reaction rates in a critical core; and many more. DOE

N92-29471# Japan Broadcasting Corp., Tokyo. Science and Technical Research Lab.

THE 1990 ANNUAL REPORT, APRIL 1990 - MARCH 1991

Mar. 1991 26 p Original contains color illustrations

Avail: CASI HC A03/MF A01

This annual report briefly describes research results and activities of 1990 (from April, 1990 to March, 1991) of the NHK Science and Technical Research Laboratories. The Laboratories are engaged in wide-ranging research and development, including the analysis of human visual and auditory sensation, research

into image pickup devices and recording materials, research into signal transmission and compression systems, and research into program production systems. These activities are categorized into three major research goals; 'new broadcast services,' 'improving existing broadcast services,' and 'basic technology to support future broadcasting.' Our research efforts over two decades were enabled to start to serve the direct satellite broadcasting and Hi-Vision (HDTV of Japan). Direct satellite broadcasting began with 24-hour service in June, 1989 on two channels of the present TV system and experimental Hi-Vision service was started via DBS. Furthermore, we are engaged in the development of new broadcast media for the early 21st century. Author

N92-32067# National Science Foundation of US, Tokyo (Japan).

NSF TOKYO REPORTS. 1991 SURVEY OF RESEARCH AND DEVELOPMENT IN JAPAN

L. H. WEBER and M. MIYAHARA Dec. 1991 15 p

(PB92-192624; REPT-MEMO-221) Avail: CASI HC A03/MF A01

A summary of statistical data on Japanese research and development expenditures for the Japanese FY-90 (April 1990 through March 1991) is given. The data are based on a survey conducted by the Statistics Bureau of the Management and Coordination Agency of the Japanese Government. The survey covered approximately 16,400 organizations, including 12,700 private companies, 2,200 universities and 1,500 research institutes. Author

N92-32068# National Science Foundation of US, Tokyo (Japan).

NSF TOKYO REPORTS. GENERAL OUTLINE OF JFY 1991 GOVERNMENT SCIENCE AND TECHNOLOGY BUDGET

L. H. WEBER and M. MIYAHARA Jan. 1992 43 p

(PB92-192640; REPT-MEMO-222) Avail: CASI HC A03/MF A01

The FY-91 gross total of the Japanese Government's annual budget for all science and technology activities amounted to 2,022.6 billion Japanese yen. This represents an increase of 5.3 percent over the previous fiscal year level. A detailed summary is given in both tabular and narrative form of how total funding was allocated by agency and by major project. Author

N92-32457# Nagoya Univ. (Japan). Solar-Terrestrial Environment Lab.

STEL Annual Report, 1991 - 1992

1992 25 p

Avail: CASI HC A03/MF A01

An overview of the activities of the Solar-Terrestrial Environment Laboratory of Nagoya University is presented. Individual activity summaries are given for each of the four research divisions: (1) Atmospheric Environment - which studies the behavior of trace gases and particulate matter in the atmosphere, especially in relation to chemical and transport process; (2) Ionospheric and Magnetospheric Environment - which studies the physical processes of the magnetospheric/ionospheric environment particularly through ground-based observation from the global scale point of view; (3) Heliospheric Environment - which studies by means of ground-based observations and computer simulation; and (4) Coordinated Data Analysis. Programs of the Moshiri, Kagoshima, Sakushima, Fuji, and Sakashita observatories are also reported as well as collaborative research activities. I.I.C.

N92-33594# National Science Foundation of US, Tokyo (Japan).

NSF TOKYO REPORTS. JFY 1991 R AND D BUDGET OF THE SCIENCE AND TECHNOLOGY AGENCY (STA)

Jan. 1992 28 p

(PB92-192632; REPT-MEMO-223) Avail: CASI HC A03/MF A01

The Japan Fiscal Year 1991 budget for Japan's Science and Technology Agency (STA) amounted to 522,561 million Japanese yen. This represented an increase of 5.6 percent over the previous fiscal year, and accounted for 25.84 percent of the Japanese Government's total research and development (R&D) budget. The monies were used to fund programs in areas of special importance

to the government, including the Human Frontier Science Program, fellowships for foreign scientists, special coordination funds for promoting science and technology (S&T), government labs attached to STA, and public corporation research institutes. A detailed explanation of how the budget was allocated is provided.

Author

N92-70608 Science and Technology Agency, Tokyo (Japan).

SPACE IN JAPAN, 1988-1989

1989 48 p

Avail: CASI HC A03

An overview is presented of the space program in Japan. Besides Japan's space development policy, also presented is its national organizations for space activities, international cooperation, a brief history of space activities, table of satellites, changes of space development budgets in Japan, industry's role in space activities, a profile of members, and addresses of organizations related to space development.

E.R.

N92-71010 New Energy and Industrial Technology Development Organization, Tokyo (Japan).

ENERGY TECHNOLOGY, FY 1991 RESEARCH AND DEVELOPMENT PROJECTS, 1

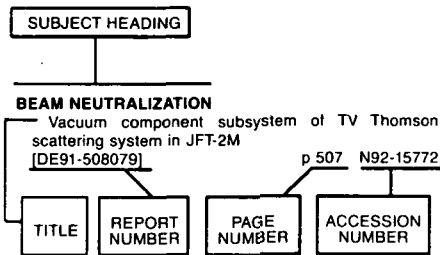
Apr. 1991 113 p

(DE92-526291; NEDO-OS-9101) Avail: CASI HC A06/MF A02

This report summarizes implementation plans of research and development projects which are administered by New Energy and Industrial Technology Development Organization (NEDO) in the fiscal year of 1991. The implementation plans consist of ten divisions: Coal Energy Technology; Solar Energy Technology; Geothermal Energy Development Technology; Development of Energy Conversion and Storage Technology; Alcohol and Biomass Energy Technology; Geothermal Resources; Coal Resources Development; Superconductivity Technology Development Project Team; Planning Department Projects; and New Energy Information Center divisions. Themes, research and development contents, and implementation plans in FY-91 are shown for all projects which are included in these ten divisions. Annual budgets of FY-91 for individual research and development contents are expressed. Furthermore, the implementation plans for three projects are also provided, as for the wind turbine power generation, the municipal energy center fuel cell power, and the optimum use of night electric power, which are related to the NEDO's activities.

DOE

Typical Subject Index Listing



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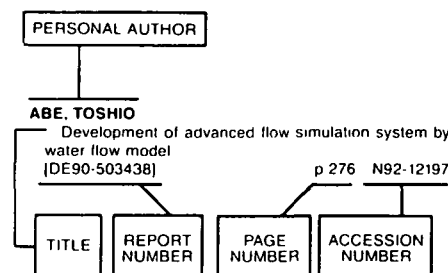
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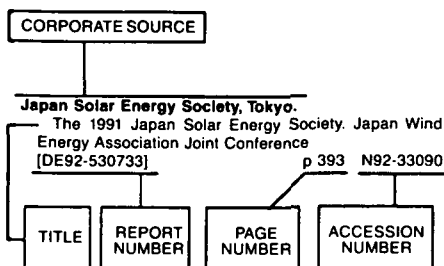
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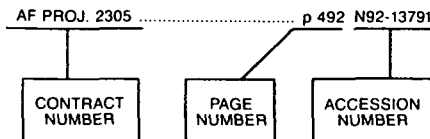
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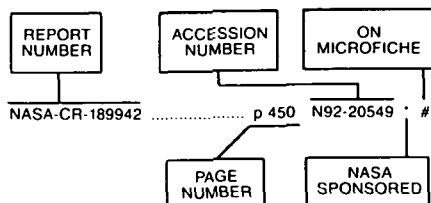
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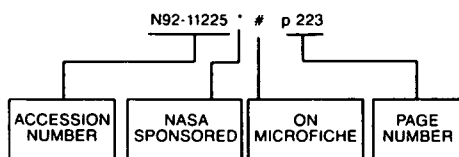
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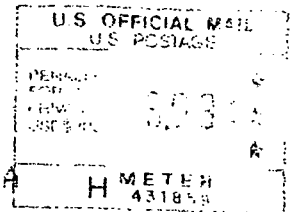
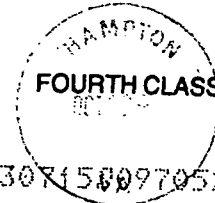
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